REPORT NUMBER 142
JANUARY 1964

STRESS ANALYSIS MAIN LANDING GEAR

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XV-5A LIFT FAN

FLIGHT RESEARCH AIRCRAFT PROGRAM

JANUARY 1964

ADVANCED ENGINE AND TECHNOLOGY DEPARTMENT
FLIGHT PROPULSION DIVISION
GENERAL ELECTRIC COMPANY
Cincinnati, Ohio 45215

TABLE OF CONTENTS

TABLE OF CONTENTS (con't)

TABLE OF CONTENTS (con't)

TABLE OF CONTENTS (con't)

TABLE OF CONTENTS (con't)

TABLE OF CONTENTS (con't)

PREFACE

This report consists of data substantiating the structural integrity of the main landing gear shock strut.

This shock strut is for the Ryan Aeronautical Co., XV-5A Airplane. The basic landing and ground handling loads used were obtained from the basic loads report as furnished by Ryan.

REFERENCE;

1. Ryan Basic Loads

2. MIL-HDBK-5

3. Houghton Packing Handbook

4. "Strength of Materials" Timoshenko, Part 1

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK						Ryan
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE
APR						

DRAWING REFERENCES

Outer Cylinder	1510L144
Inner Cylinder (Piston)	1510L140
Upper Torque Arm	1510L125
Lower Torque Arm	1510L126
Drag Brace Assembly	1510L200
Lower Drag Brace Assembly	1510L211
Upper Drag Brace Assembly	1510L212
Link	1510L213
Triangle Frame	1510L214
Bolt-Link Frame	1510L223
Bolt-Hinge	1510L224
Bolt-Upper Segment	1510L225
Bolt-Actuator	1510L226
Retraction Cylinder Assembly	1510L300
Cylinder	1510L301
Cylinder Head	1510L302
Piston	1510L303
Side Brace Assembly	1510L500
Tube-Side Brace	1510L501
Rod End, Angle	1510L502

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK						Ryan
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 3

DRAWING REFERENCES (con't)

Rod End, Straight	1510L503
Bearing Retainer	1510L103
Lower Bearing	1510L104
Bearing Adapter	1510L105
Follower	1510L106
Piston Head	1510L107
Vee Brace Assembly	1510L400
Vee Assembly	1510L401
Cluster Fitting	1510L403
Bolt-Upper Drag Brace Attach	1510L404
Universal Joint	1510L406
Bolt-Upper Side Brace	1510L414
Clevis Bolt-Stabilizer	1510L416
Stabilizer Beam	1510L402
Bolt-Universal	1510L407
Gland Nut	1510L109
Orifice Tube	1510L114
Cylinder Bulkhead	1510L123
Retaining Nut	1510L124
Torque Arm End Bolt	1510L127

DRAWING REFERENCES (con't)

Torque Arm Apex Bolt	1510L129
Bolt-Side Brace	1510L131
Bolt-Drag Brace	1510L133
Bolt-Shock Strut Attach	1510L135

MINIMUM MARGINS OF SAFETY

PART	SECTION	CRITICAL COND.	LOADING					MARGIN OF SAFETY
			BEND	TEN.	COMP.	TORSION	SHEAR	
Cylinder 1510L144	A-A	6	X	fht	X	X	X	.36
	B-B	6	X	fht	X	X	X	.29
	C-C	6	X	fht	X	X	X	.11
	D-D	37	X	fht	X		X	0
	Side Brace Lug	2				Shear-Brg.		.11
	Side Brace Lug	6				Shear-Brg.		.06
	Side Brace Lug	6	X	X			X	.02
	Cyl. Attach Lug	6	X		X		X	.63
Piston 1510L140	A-A	2 PT. T.D.	X		X			0
	B-B	"	X		X			.067
	C-C	"					X	.08
	D-D	"	X		X			.24
	E-E	"	X					.56
	F-F	"	X					.037
	G-G	"	X					.73
	H-H	"	X					Large
Upper Torque Arm 1510L125	A-A	6	X					.19
	B-B	6	X					.21
	C-C	6	X	X				.17
	Lug	6				Shear-Brg.		.04
Drag Brace 1510L200								
						Column		Stable

CALC			REVISED	DATE	MAIN GEAR XV5A	1510L
CHECK						Ryan
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 11
APR						

MINIMUM MARGINS OF SAFETY

PART	SECTION	CRITICAL COND.	LOADING					MARGIN OF SAFETY
			BEND	TEN.	COMP.	TORSION	SHEAR	
Lower Drag Brace 1510L211	Lug	6		X				.13
	Lug	6				Shear-Brg.		.19
	Tube	6		X				.12
Upper Drag Brace 1510L212	Lug	6				Shear-Brg.		.16
	Lug	6				Shear-Brg.		.16
	Lug	6	X				X	Large
Link 1510L213				X				Large
						Shear-Brg.		Large
Triangle Frame 1510L214	A-A	80% Retracted	X	X			X	.78
	Lug					Shear-Brg.		.38
	Lug					Shear-Brg.		.96
Bolt-Hinge 1510L224	Max. Bend.	6	X					.25
	Shear Face	6	X				X	.11
Bolt-Upper Segment 1510L225	Max. Bend.		X					Large
	Shear Face		X				X	Large
Bolt-Actuator 1510L226	Max. Bend.		X					.98
	Shear Face		X				X	Large
Retraction Actuator Assembly 1510L300						Column		.02
	Cylinder			fht				.44
	Piston			fht				Large
	Cyl. Head			X		Shear-Brg.		.70
	Bolt							1.22

CALC			REVISED	DATE	MAIN GEAR XV5A	1510 L
CHECK						Ryan
APR					H W LOUD MACHINE WORKS INC	PAGE
APR					887 EAST SECOND ST. POMONA, CALIFORNIA	12

MINIMUM MARGINS OF SAFETY

PART	SECTION	CRITICAL COND.	LOADING					MARGIN OF SAFETY
			BEND	TEN.	COMP.	TORSION	SHEAR	
Tube-Side Brace 1510L501		38				Column		.01
		10		X				.02
Rod End-Angle 1510L502	Lug					Shear-Brg.		.45
	A-A		X	X				Large
Rod End-Straight 1510L503	Lug					Shear-Brg.		.49
	A-A			X				.48
Lower Brace 1510L104						Brg.		0
Brg. Adapter 1510L105					X			Large
Follower 1510L106					X			Large
Piston Head 1510L107						Brg.		.21
Gland Nut 1510L109	A		X				X	2.84
	B		X	X				2.28
	Threads						X	Large
Orifice Tube 1510L114						Column		.95
Vee Brace 1510L401	A-A	38	X	X			X	.54
	B-B	40	X	X			X	.005
	C-C	40	X	X			X	.22
	Lug A	6	X		X		X	.45
	Lug B		X	X			X	.04
	Lug G		X		X		X	.06
Cluster Fitting 1510L403	Lug					Shear-Brg.		.09
	Lug					Shear-Brg.		.01
	A-A		X	X				.05

CALC			REVISED	DATE	MAIN GEAR XV5A	1510L
CHECK						Ryan
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 13
APR						

MINIMUM MARGINS OF SAFETY

PART	SECTION	CRITICAL COND.	LOADING					MARGIN OF SAFETY
			BEND	TEN.	COMP.	TORSION	SHEAR	
Bolt-Upper Drag Brace 1510L404	Max. Bend.	6	X					.20
	Shear Face	6	X				X	.11
Universal Joint 1510L406	Lug	6				Shear-Brg.		Large
	X-X	6	X		X		X	Large
Bolt-Side Brace 1510L414	Max. Bend.		X					.33
	Shear Face		X				X	.24
Clevis Bolt 1510L416			X	X				1.07
Stabilizer Beam 1510L402	A-A		X	X				.29
	B-B		X	X				2.98
	C-C		X	X				Large
	Lug M			X				.21
	Lug L			X				Large
Bolt-Universal 1510L407	Shear Face	6	X				X	.24
	Max. Bend.	6	X					Large
Cylinder Bulkhead 1510L123	End Wall							.14
	Threads						X	Large
End Bolt Torque Arm 1510L127	Max. Band.	6	X					.01
	Shear Face	6	X				X	.06
Apex Bolt 1510L129		6					X	.31
Bolt-Side Brace 1510L131	Max. Bend.		X					.41
	Shear Face		X				X	.40
Bolt-Drag Strut 1510L133	Max. Bend.		X					.19
	Shear Face		X				X	.15
Bolt-Cyl. Attach 1510L135	Max. Band.		X					.1
	Shear Face		X				X	.29

			REVISED	DATE	MAIN GEAR XV5A	1510L
CALC						
CHECK						Ryan
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 14

DISCUSSION

Tne effect of strut bending is considered as being small due to the tripod configuration of the gear. The tripod configuration will minimize strut bending to such a degree that no deflection analysis for the gear is presented. It is considered the margins of safety maintained are sufficient for any local secondary effects.

STRESS SYMBOLS

ALLOWABLE STRESSES:

F_{t_u} = Allowable Ultimate Tensile Stress - psi

F_{t_y} = Allowable Yield Tensile Stress - psi

F_b = Allowable Bending Stress - psi

F_{b_r} = Allowable Bearing Stress - psi

F_{c_u} = Allowable Ultimate Compressive Stress - psi

F_{c_y} = Allowable Yield Compressive Stress - psi

F_{cc} = Upper Limit of Column Stress For Local Failure - psi

F_{co} = Upper Limit of Column Stress for Primary Failure

F_{st} = Allowable Torsional Stress - psi

F_{su} = Allowable Shear Stress - psi

ALLOWABLE LOADS:

P_{bru} = Ultimate Allowable Shear Bearing Load - lbs.

P_{tu} = Ultimate Allowable Tension Load - lbs.

STRESS RATIOS:

R_{bu} = Ultimate Tension or Compression Bending Modulus Stress Ratio

R_c = Compressive Stress Ratio

R_t = Tension Stress Ratio

R_{ht} = Tension or Compression Hoop Stress Ratio

STRESS SYMBOLS (con't)

STRESS RATIOS: (con't)

R_{su} = Ultimate Trasnverse Shear Stress Ratio

R_{st} = Torsion Stress Ratio

STRESSES:

f_t = Tensile Stress - psi

f_b = Bending Stress - psi

f_{br} = Bearing Stress - psi

f_c = Compressive Stress - psi

f_s = Shear Stress - psi

f_{st} = Torsional Shear Stress - psi

f_{ht} = Hoop Tension Stress - psi

f_{hc} = Hoop Compressive Stress - psi

MISCELLANEOUS SYMBOLS:

P = Axial Load - lbs.

M = Bending Moment - in. - lbs.

T = Torsional Moment - in. - lbs.

S = Shear Force - lbs.

E = Tensile Modulus of Elasticity - psi

Ec = Compressive Modulus of Elasticity - psi

G = Modulus of Rigidity - psi

STRESS SYMBOLS (con't)

MISCELLANEOUS SYMBOLS: (con't)

	=	Radius of Gyration - in.
I	=	Moment of Inertia - $(in.)^4$
e	=	Eccentricity - in.
O. D.	=	Outer Diameter - in.
I. D.	=	Inner Diameter - in.
A	=	Area - $(in.)^2$
c	=	Distance from Neutral Axis to Extreme Fiber - in.
c	=	Fixity Coefficient
l	=	Length - in.
t	=	Thickness
	=	Angular Deflection - degrees
	=	Linear Deflection - in.
M_A	=	Allowable Bending Moment - in. - lbs.
P_A	=	Allowable Load - lbs.
T_A	=	Allowable Torsional Moment - in. - lbs.
PSI	=	Pounds per Square Inch
LBS	=	Pounds
IN.	=	Inch
Q	=	First Moment of Area
	=	Poisson's Ratio

STRESS SYMBOLS (con't)

MISCELLANEOUS SYMBOLS: (con't)

A_t : Tension Area - $(in.)^2$

A_{br} : Bearing Area - $(in.)^2$

K : Bending Modulus of Rupture Parameter

Z : Section Modulus - $(in.)^3$

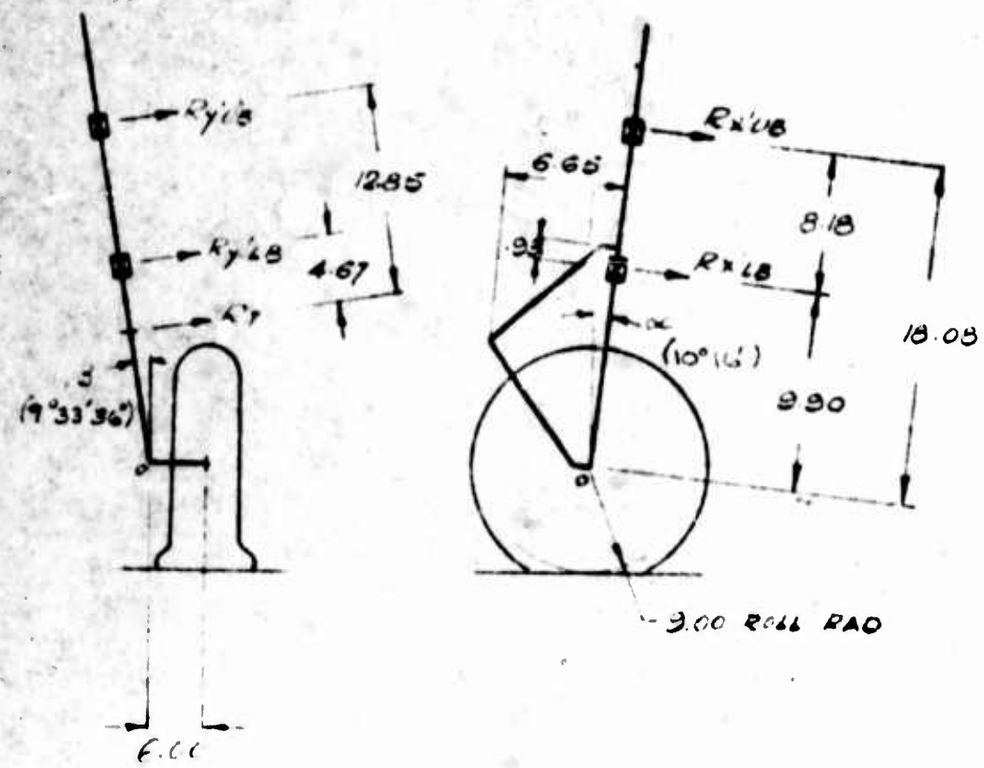
I_p : Polar Moment of Inertia - $(in.)^4$

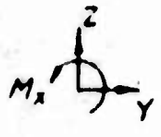
CLEO SECTION

LANDING LOADS ASSUMED APPLIED AT 20% STROKE

FE - 1.84 INCHES

GEAR FWD





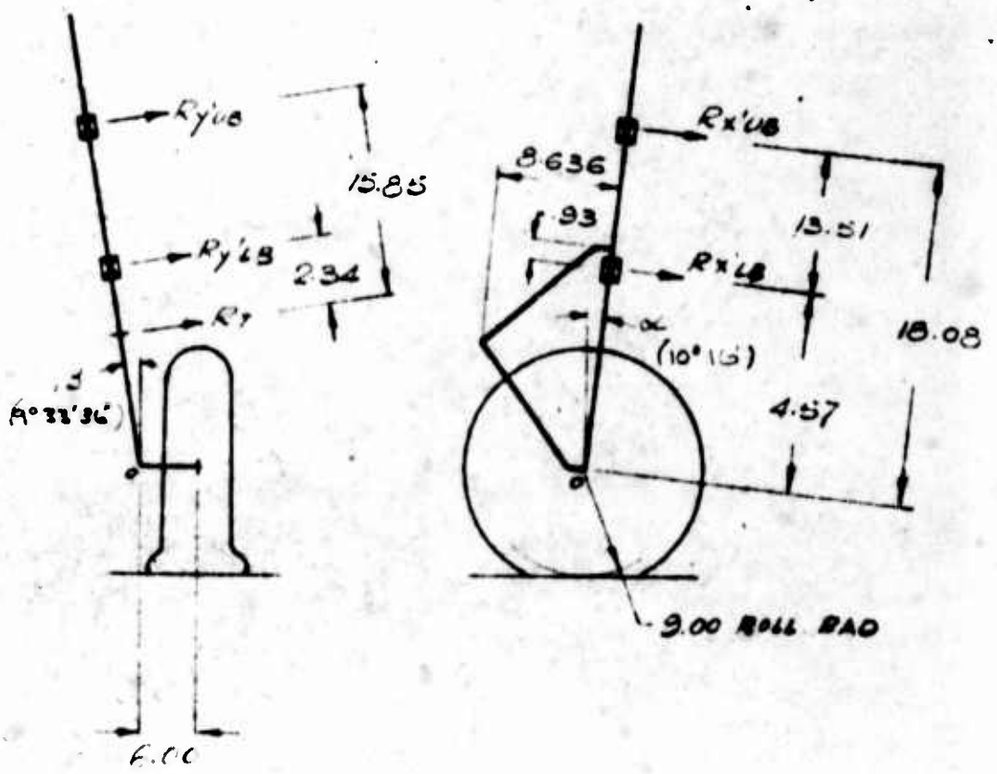
CALC	LL		REVISED	DATE	MAIN GEAR BASIC GEOMETRY	ISKL
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS INC. 887 EAST SECOND ST. POMONA CALIFORNIA	PAGE 20
APR						

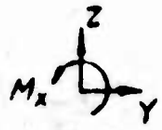
CLEO SECTION

LANDING LOADS ASSUMED APPLIED AT STATIC STROKE

F.E. - 7.17 INCHES

GEAR FWD





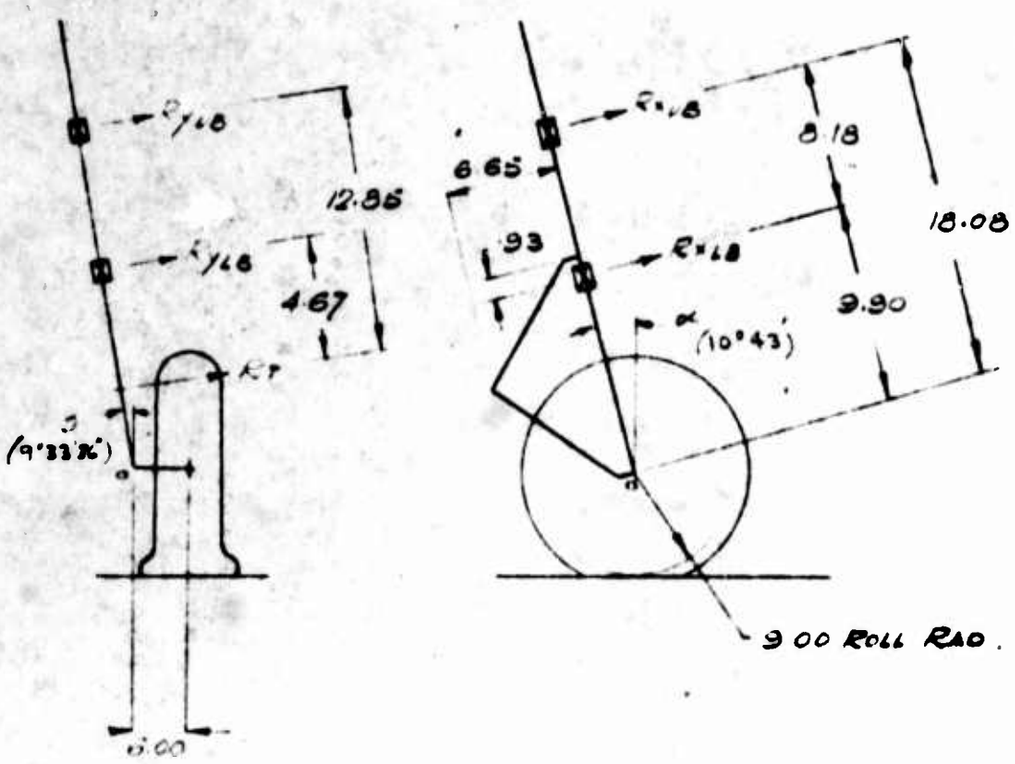
CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					BASIC GEOMETRY	RYAN
APN					H W LOUD MACHINE WORKS, INC	PAGE
APN					887 EAST SECOND ST. POMONA, CALIFORNIA	21

Oleo Section

Landing Loads Assumed Applied at 20% Stroke

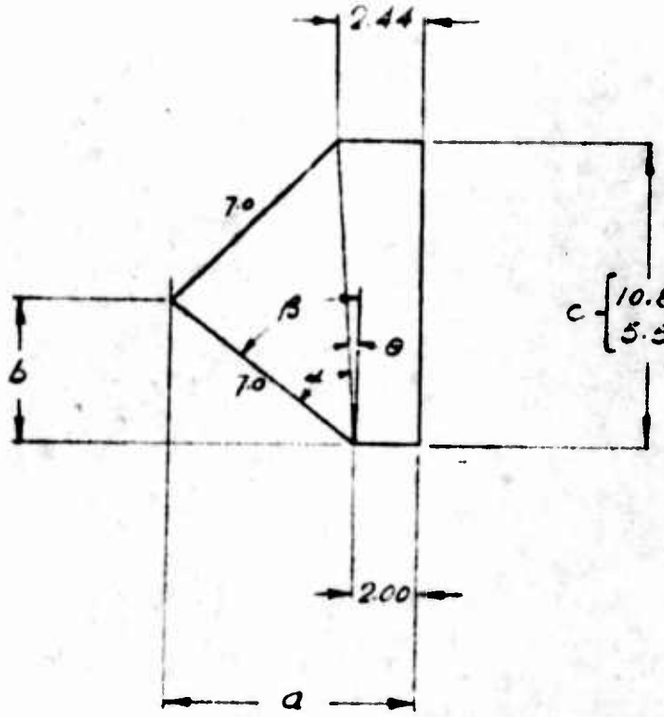
FE - 1.84 inches

Gear Aft



CALC			REVISED	DATE	Main Gear Base Geometry	1510L
CHECK						Ryan
APR					H W LOUD MACHINE WORKS, INC	PAGE
APR					887 East Second St Pomona California	22

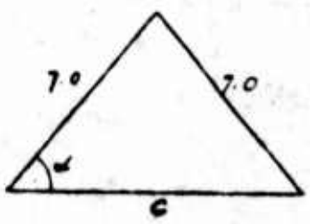
OLEO SECTION - CONT



$a = 2.0 + 7.0 \sin \beta$

$b = 7.0 \cos \beta$

$\beta = \theta + \alpha$



FE-1.84

$$\alpha = \cos^{-1} \frac{.50c}{7.0} = \cos^{-1} 5.415/10 = .7736 = 39^\circ 19'$$

FE-7.17

$$\alpha = \cos^{-1} \frac{.50c}{7.0} = \cos^{-1} 2.75/7.0 = .3929 = 66^\circ 52'$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR BASIC GEOMETRY	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 23
APR						

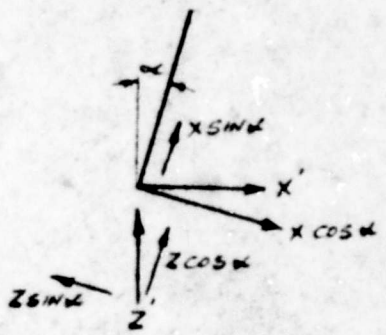
L OLEO	FE-1.84	FE-7.17
$\alpha = \cos^{-1} \frac{50C}{7.0}$	39° 19'	66° 52'
$\theta = \tan^{-1} \frac{2.44 - 2.00}{C}$	2° 19'	4° 34'
$\beta = \theta + \alpha$	41° 38'	71° 26'
$a = 2.0 + 7.0 \sin\beta$	6.650	8.636
$b = 7.0 \cos\beta$	5.232	2.229

CALC				REVISED	DATE	MAIN GEAR BASIC GEOMETRY H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	1510L RYAN PAGE 24
CHECK							
APR							
APR							

OLEO SECTION - CONT. GEAR END

BASIC FORMULAE FOR ROTATING LOADS INTO PLANE OF SHOCK STRUT

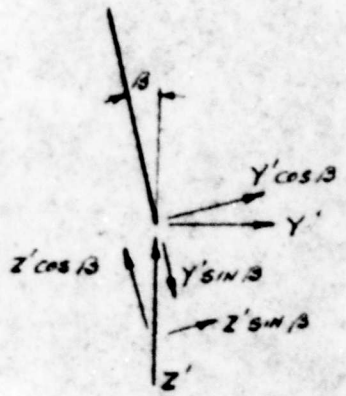
α : AFT ANGLE β : INBOARD ANGLE



$X' = X \cos\alpha - Z \sin\alpha$

$Y' = Y$

$Z' = X \sin\alpha + Z \cos\alpha$



$X'' = X' = X \cos\alpha - Z \sin\alpha$

$Y'' = Y' \cos\beta + Z' \sin\beta = X \sin\alpha \sin\beta + Y \cos\beta + Z \cos\alpha \sin\beta$

$Z'' = -Y' \sin\beta + Z' \cos\beta = X \sin\alpha \cos\beta - Y \sin\beta + Z \cos\alpha \cos\beta$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	15102
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 25
APR						

OLEO SECTION - CONT GEAR FWD

2 POINT

$\alpha = 10° 16'$ $\beta = 9° 33' 36''$

$\cos \alpha = .9840$ $\cos \beta = .9861$

$\sin \alpha = .1782$ $\sin \beta = .1661$

$X'' = .9840X - .1782Z$

$Y'' = .0296X + .9861Y + .1634Z$

$Z'' = .1757X - .1661Y + .9703Z$

---

3 POINT

$\alpha = 7°$ $\beta = 9° 33' 36''$

$\cos \alpha = .9926$ $\cos \beta = .9861$

$\sin \alpha = .1219$ $\sin \beta = .1661$

$X'' = .9926X - .1219Z$

$Y'' = .0202X + .9861Y + .1649Z$

$Z'' = .1202X - .1661Y + .9788Z$

TAIL DOWN

$\alpha = 16°$ $\beta = 9° 33' 36''$

$\cos \alpha = .9613$ $\cos \beta = .9861$

$\sin \alpha = .2756$ $\sin \beta = .1661$

$X'' = .9613X - .2756Z$

$Y'' = .0458X + .9861Y + .1597Z$

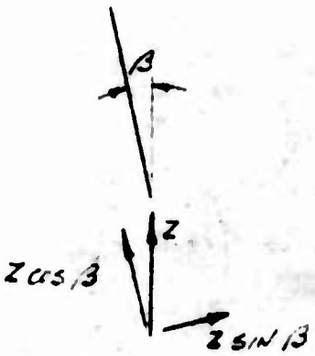
$Z'' = .2718X - .1661Y + .9479Z$

CALC			REVISED	DATE	MAIN GEAR	15101
CHECK					BASIC LOADS	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 26
APR						

OLEO SECTION - CONT.

GEAR FWD

SPIN UP & SPRING BACK



$X'' = X$

$Y'' = Z \sin \beta$

$Z'' = Z \cos \beta$

$\beta = 9° 33' 36''$

$\cos \beta = .9861$

$\sin \beta = .1661$

$X'' = X$

$Y'' = Z \sin \beta$

$Z'' = Z \cos \beta$

$X'' = X$

$Y'' = .1661 Z$

$Z'' = .9861 Z$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					BASIC LOADS	RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 27
APR						

OLEO SECTION - CONT GEAR END

2 POINT.

$M_{X_0}'' = 6.00Z + 9.00Y$

$M_{Y_0}'' = 0$

$M_{Z_0}'' = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS REF p 26

$M_{X_0}'' = .9840(6.0Z + 9.0Y) - .1782(-6.0X)$

$= \underline{1.0692X + 8.856Y + 5.904Z}$

$M_{Y_0}'' = .0296(6.0Z + 9.0Y) + .9861(0) + .1634(-6.0X)$

$= \underline{-.9804X + .2664Y + .1776Z}$

$M_{Z_0}'' = .1757(6.0Z + 9.0Y) - .1661(0) + .9703(-6.0X)$

$= \underline{-5.8218X + 1.5813Y + 1.0542Z}$

---

3 POINT

$M_{X_0}'' = 6.00Z + 9.00Y$

$M_{Y_0}'' = 0$

$M_{Z_0}'' = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS REF p 26

$M_{X_0}'' = .9926(6.0Z + 9.0Y) - .1219(-6.0X)$

$= \underline{.7314X + 8.9334Y + 5.9556Z}$

$M_{Y_0}'' = .0202(6.0Z + 9.0Y) + .9861(0) + .1649(-6.0X)$

$= \underline{-.9894X + .1818Y + .1212Z}$

$M_{Z_0}'' = .1202(6.0Z + 9.0Y) - .1661(0) + .9788(-6.0X)$

$= \underline{-5.8728X + 1.0818Y + .7212Z}$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 28

CLEO SECTION - CONT

GEAR FWD

TAIL DOWN

$M_{x_0''} = 6.00Z + 9.00Y$

$M_{Y_0'} = 0$

$M_{Z_0''} = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS - REF p 26

$M_{x_0''} = .9613(6.0Z + 9.0Y) - .2756(-6.0X)$

$= 1.6536X + 8.6517Y + 5.7678Z$

$M_{Y_0'} = .0458(6.0Z + 9.0Y) + .9861(0) + .1597(-6.0X)$

$= -.9582X + .4122Y + .2748Z$

$M_{Z_0'} = .2718(6.0Z + 9.0Y) - .1661(0) + .9479(-6.0X)$

$= -5.6874X + 2.4462Y + 1.6308Z$

SPIN UP & SPRING BACK

$M_{x_0''} = 6.00Z + 9.00Y$

$M_{Y_0'} = 0$

$M_{Z_0'} = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS - REF p 27

$M_{x_0''} = 9.0Y + 6.0Z$

$M_{Y_0''} = .1661(-6.0X)$

$= -.9966X$

$M_{Z_0''} = .9861(-6.0X)$

$= -5.9166X$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	15106
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 29

OLEO SECTION - CONT. GEAR FWD

2 POINT.

$M_{x_0^\circ} = 6.00Z + 9.00Y$

$M_{y_0^\circ} = 9.00X$ (FOR BRAKING CONDITIONS ONLY)

$M_{z_0^\circ} = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS - REF p. 26

$M_{x_0^\circ} = .9840(6.0Z + 9.0Y) - .1782(-6.0X)$

$= 1.0692X + 8.856Y + 5.904Z$

$M_{y_0^\circ} = .0236(6.0Z + 9.0Y) + .9861(9.0Y) + .1634(-6.0X)$

$= .9804X + 9.1413Y + .1776Z$

$M_{z_0^\circ} = .1757(6.0Z + 9.0Y) - .1661(9.0Y) + .9703(-6.0X)$

$-5.8218X + .0864Y + 1.0542Z.$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 30

BEARING REACTIONS

FE - 1.84 INS

FOR CONDITIONS 2 POINT, 3 POINT TAIL DOWN SPIN UP & SPRING BACK

$$R_T = M_{Z_0}'' / 6.65 = .1504\, M_{Z_0}''$$

$$-8.18\, R_{X''_{LB}} - 18.08\, X_0'' + M_{Y_0}'' = 0$$

$$R_{Y''_{LB}} = -2.2103\, X_0'' + .1222\, M_{Y_0}''$$

$$8.18\, R_{X''_{UB}} - 9.90\, X_0'' + M_{Y_0}'' = 0$$

$$R_{X''_{UB}} = 1.2102\, X_0'' - .1222\, M_{Y_0}''$$

$$8.18\, R_{Y''_{LB}} + 18.08\, Y_0'' + M_{X_0}'' + 12.85\, R_T = 0$$

$$R_{Y''_{LB}} = -2.2103\, Y_0'' - .1222\, M_{X_0}'' - 1.5709\, R_T$$

$$-8.18\, R_{Y''_{UB}} + 9.90\, Y_0'' + M_{X_0}'' + 4.67\, R_T = 0$$

$$R_{Y''_{UB}} = 1.2102\, Y_0'' + .1222\, M_{X_0}'' + .5709\, R_T$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					BASIC LOADS	RYAN.
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 31
APR						

BEARING REACTIONS - CONT

FE-717 INS

FOR CONDITIONS 2 POINT, 3 POINT, TAIL DOWN, SPIN UP & SPRING BACK

$R_T = M_{Z_0}'' / 8.636 = .1158\ M_{Z_0}'$

$-13.51\ R_{X_{LB}}'' - 18.08\ X_0' + M_{Y_0}' = 0$

$R_{X_{LB}}' = -1.3383\ X_0'' + .0740\ M_{Y_0}'$

$13.51\ R_{X_{UB}}' - 4.57\ X_0' + M_{Y_0}' = 0$

$R_{X_{UB}}' = .3383\ X_0' - .0740\ M_{Y_0}'$

$13.51\ R_{Y_{LB}}' + 18.08\ Y_0' + M_{X_0}' + 15.85\ R_T = 0$

$R_{Y_{LB}}' = -1.3383\ Y_0' - .0740\ M_{X_0}'' - 1.1732\ R_T$

$-13.51\ R_{Y_{UB}}' + 4.57\ Y_0' + M_{X_0}' + 2.34\ R_T = 0$

$R_{Y_{UB}}' = .3383\ Y_0' + .0740\ M_{X_0}' + .1732\ R_T$

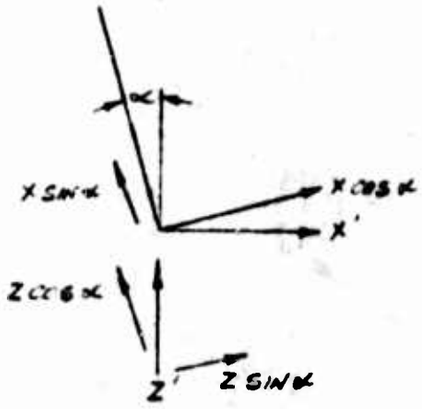
CALC			REVISED	DATE	MAIN GEAR BASE LOADS	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 32
APR						

OLEO SECTION - CONT

GEAR AFT

BASIC FORMULAE FOR ROTATING LOADS INTO PLANE OF SHOCK STRUT

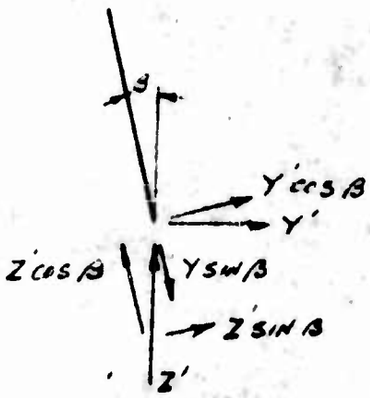
α = FWD ANGLE β = INB'D ANGLE.



$X' = X \cos\alpha + Z \sin\alpha$

$Y' = Y$

$Z' = X \sin\alpha + Z \cos\alpha$



$X'' = X' = X \cos\alpha + Z \sin\alpha$

$Y'' = Y' \cos\beta + Z' \sin\beta = X \sin\alpha \sin\beta + Y \cos\beta + Z \cos\alpha \sin\beta$

$Z'' = -Y \sin\beta + Z' \cos\beta = X \sin\alpha \cos\beta - Y \sin\beta + Z \cos\alpha \cos\beta$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	15106
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 33
APR						

OLEO SECTION - CONT

GEAR AFT

2 POINT

$\alpha = 10°.43'$ $\beta = 9°.33.36"$

$\cos \alpha = .9825$ $\cos \beta = .9861$

$\sin \alpha = .1860$ $\sin \beta = .1661$

$X' = .9825X + .1860Z$

$Y' = .0309X + .9861Y + .1632Z$

$Z' = .1834X - .1661Y + .9688Z$

---

2 POINT.

$M_{X'_0} = 6.00Z + 9.00Y$

$M_{Y'_0} = 0$

$M_{Z'_0} = -6.00X$

USING BASIC LOADS FORMULAE TO ROTATE MOMENTS (SEE ABOVE)

$M_{X'_0} = .9825(6.0Z + 9.00Y) + .1860(-6.0X)$

$= -1.1160X + 8.8425Y + 5.8950Z$

$M_{Y'_0} = .0309(6.0Z + 9.0Y) + .9861(0) + .1632(-6.0X)$

$= -.9792X + .2781Y + .1854Z$

$M_{Z'_0} = .1834(6.0Z + 9.0Y) - .1661(0) + .9688(-6.0X)$

$= 5.8128X + 1.6506Y + 1.1004Z$

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	15101
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 34

LOADS & REACTIONS - CONT

LIMIT LOAD

CONDITION: 2 PT LEVEL SPRING BACK - GEAR FWD

	X_o	Y_o	Z_o	
	-8640	0	11950	Σ
X'_o	1.0			-8640
Y'_o			.1561	1985
Z'_o			.9861	11784
M_{xo}		9.0	6.0	71700
$M_{y'o}$	-.9966			8611
$M_{z'o}$	-5.9166			51119

	X_o	Y_o	Z'_o	$M_{x'o}$	$M_{y'o}$	$M_{z'o}$	R_T	
	-8640	1985	11784	71700	8611	51119	7688	Σ
R_T						.1504		7688
$R_{x'LB}$	-2.2103				.1222			21049
$R_{x'LB}$	1.2102				-.1222			-11508
$R_{y'LB}$		-2.2103		-.1222			-.5708	-25226
$R_{y'LB}$		1.2102		.1222			.5708	13563
R''_{LB}								22860
R'_{LB}								19350

R''_{LB} : $R_{x''LB}$ ⟷ $R_{y'LB}$

R'_{LB} : $R_{x'LB}$ ⟷ $R_{y'LB}$

R_T : TORQUE ARM APEX LOAD

			REVISED	DATE
CALC				
CHECK				
APP				
APP				

MAIN GEAR

BASIC LOADS

H W LOUD MACHINE WORKS, INC.
887 EAST SECOND ST., POMONA, CALIFORNIA

1610L

RYAN

PAGE 35

LEADING REACTIONS - CONT

LIMIT LOAD

CONDITION: 2 PT TAIL DOWN SPRING BACK - GEAR FWD

	X_o	Y_o	Z_o	
	-9876	0	11670	Σ
X_o	1.0			-9876
Y_o			.1661	1938
Z_o			.9861	11509
M_{x_o}		9.0	6.0	70020
M_{y_o}	.9966			9842
M_{z_o}	-5.9166			58432

	X_o	Y_o	Z_o	M_{x_o}	M_{y_o}	M_{z_o}	R_T	
	-9876	1938	11508	70020	9842	58432	8788	Σ
R_T						.1504		8788
$R_{x_{LB}}$	-2.2103				.1222			23032
R_{x_B}	1.2102				-.1222			-13153
$R_{y_{LB}}$		-2.2103		-.1222			-1.5709	-26645
$R_{y_{LE}}$		1.2102		.1222			.5709	15918
R_{LB}								35230
R_{LB}								20650

R_{LB} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_{LE} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_T = TORQUE ARM APEX LOAD

CALC				REVISED	DATE	MAIN GEAR BASIC LOADS	15101
CHECK							RYAN
APR						H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA CALIFORNIA	PAGE 36
APR							

BEARING REACTIONS - CONT

LIMIT LOAD

CONDITION: 2 PT DRIFT OUTBD WHEEL - GEAR AFT.

	X_o	Y_o	Z_o	
	0	3643	6072	Σ
X_o	.9825	0	.1860	1129
Y_o	.0309	.9861	.1632	4583
Z_o	.1834	.1661	.9608	6488
M_{x_o}	-1.1160	3 8425	5.8950	6.8008
M_{y_o}	-.9792	.2791	.1854	2139
M_{z_o}	5.8128	1.6506	1.1004	12695

	X_o	Y_o	Z_o	M_{x_o}	M_{y_o}	M_{z_o}	R_T	
	1129	4583	6488	68008	2139	12695	1909	Σ
R_T						.1504		1909
$R_{x_{LB}}$	-2.2103				.1222			-2234
R_{x_B}	1.2102				-.1222			1105
$R_{y_{LB}}$		-2.2103		-.1222			-1.5709	-21440
R_{y_B}		1.2102		.1222			.5709	14947
R_{LB}								21450
R_{LB}								14966

R_{LB} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_{LB} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_T = TOGGLE ARM APEX LOAD

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					BASIC LOADS	RYAN
APP					H W LOUD MACHINE WORKS, INC	PAGE
APP					887 EAST SECOND ST. POMONA, CALIFORNIA	37

BEARING REACTIONS - CONT

LIMIT LOAD

CONDITION: 2 PT. BRAKED ROLL - GEAR FWD.

	X_o	Y_o	Z_o	
	4634	0	6522	Σ
X_o	.9840	0	-.1782	3399
Y_o	.0296	.9861	.1634	1203
Z_o	.1757	-.1661	.9703	7142
M_{x_o}	1.0692	8.856	5.904	43461
M_{y_o}	-.9804	9.1413	.1776	-3395
M_{z_o}	-5.8218	.0864	1.0542	-20103

	X_o	Y_o	Z_o	M_{x_o}	M_{y_o}	M_{z_o}	R_T	
	3399	1203	7142	43461	-3395	-20103	-2328	Σ
R_T						.1158		-2328
$R_{x_{LB}}$	-1.3388				.0740			-4798
$R_{x_{LS}}$	.3388				-.0740			1400
$R_{y_{LB}}$		-1.3383		-.0740			-.1732	-2095
$R_{y_{LB}}$		.3383		.0740			.1732	6993
R_{LB}								5236
R_{LS}								7024

R_{LS} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_{LS} = $R_{x_{LB}}$ ⟷ $R_{y_{LB}}$

R_T = TORQUE ARM APEX LOAD

CALC	[illegible]		REVISED	DATE	MAIN GEAR BASIC LOADS	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 38.
APR						

CYLINDER BENDING MOMENTS

LANDING CONDITION

M_{XTA} - = R_{YLB} (.93)

M_{XTA} + = R_{YLB} (.93) + R_T (4.67 + .93)

M_{YTA} - = - R_{XLB} (.93)

M_{YTA} + = - R_{XLB} (.93)

M_{XOB} - = R_{YLB} (1.531) + R_T (4.67 + 1.531)

M_{XOB} + = R_{YLB} (1.531) + R_T (4.67 + 1.531)

M_{YOB} - = - R_{XLB} (1.531)

M_{YOB} + = - R_{XLB} (1.531) - R_{ZOB} (4.829)

M_{XSB} - = R_{YLB} (1.659) + R_{YOB} (1.659 - 1.531) + R_T (4.67 + 1.659)

M_{XSB} + = R_{YLB} (1.659) + R_{YOB} (1.659 - 1.531) + R_T (4.67 + 1.659) - R_{ZSB} (3.023)

M_{YSB} - = - R_{XLB} (1.659) - R_{XOB} (1.659 - 1.531) - R_{ZOB} (4.829)

M_{YSB} + = - R_{XLB} (1.659) - R_{XOB} (1.659 - 1.531) - R_{ZOB} (4.829)

M_{XUB} = R_{YLB} (8.18) + R_{YOB} (8.18 - 1.531) + R_{YSB} (8.18 - 1.659) - R_{ZSB} (3.023) + R_T (12.85)

M_{YUB} = - R_{XLB} (8.18) - R_{XOB} (8.18 - 1.531) - R_{XSB} (8.18 - 1.659) - R_{ZOB} (4.829)

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 39
APR						

CYLINDER BENDING MOMENTS

STATIC CONDITION

M_{XTA} - = R_{YLB} (.93)

M_{XTA} + = R_{YLB} (.93) + R_T (2.34 + .93)

M_{YTA} - = - R_{XLB} (.93)

M_{YTA} + = - R_{XLB} (.93)

M_{XOB} - = R_{YLB} (1.531) + R_T (2.34 + 1.531)

M_{XOB} + = R_{YLB} (1.531) + R_T (2.34 + 1.531)

M_{YOB} - = - R_{XLB} (1.531)

M_{YOB} + = - R_{XLB} (1.531) - R_{ZOB} (4.829)

M_{XSB} - = R_{YLB} (1.659) + R_{YOB} (1.659 - 1.531) + R_T (2.34 + 1.659)

M_{XSB} + = R_{YLB} (1.659) + R_{YOB} (1.659 - 1.531) + R_T (2.34 + 1.659) - R_{ZSB} (3.023)

M_{YSB} - = - R_{XLB} (1.659) - R_{XOB} (1.659 - 1.531) - R_{ZOB} (4.829)

M_{YSB} + = - R_{XLB} (1.659) - R_{XOB} (1.659 - 1.531) - R_{ZOB} (4.829)

M_{XUB} = R_{YLB} (13.51) + R_{YOB} (13.51 - 1.531) + R_{YSB} (13.51 - 1.659) - R_{ZSB} (3.023) + R_T (15.85)

M_{YUB} = - R_{XLB} (13.51) - R_{XOB} (13.51 - 1.531) - R_{XSB} (13.51 - 1.659) - R_{ZOB} (4.829)

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS	15101
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 40

CONDITION 6 2PT TAIL DOWN SPRING BACK

	$R_{x_{SB}}$	$R_{y_{SB}}$	$R_{z_{SB}}$	$R_{x_{OB}}$	$R_{y_{OB}}$	$R_{z_{OB}}$	
	-.42	287	-229	14835	-19358	20994	Σ
$R_{x_{SB}}$	.9613	-	-.2756				23
$R_{y_{SB}}$	.0458	.9861	.1597				245
$R_{z_{SB}}$	.2718	-.1661	.9479				-276
$R_{x_{OB}}$				.9613	-	-.2756	8475.
$R_{y_{OB}}$				.0459	.9861	.1597	-15057
$R_{z_{OB}}$				.2718	-.1661	.9479	27148

	$R_{x_{LG}}$	$R_{y_{LG}}$	$R_{x_{LG}}$	$R_{y_{LG}}$	$R_{x_{SB}}$	$R_{y_{SB}}$	$R_{z_{SB}}$	$R_{x_{OB}}$	$R_{y_{OB}}$	$R_{z_{OB}}$	R_T	
	-13032	26648	18755	-15918	23	245	-276	8475	-15057	27148	-8788	Σ
$M_{x_{TA}}^{-}$		.93										24780
$M_{x_{TA}}^{+}$		.93									5.60	-24483
$M_{y_{TA}}^{-}$	-.93											21420
$M_{y_{TA}}^{+}$	-.93											21429
$M_{x_{OB}}^{-}$		1.531									6.201	-13700
$M_{x_{OB}}^{+}$		1.531									6.201	-13700
$M_{y_{OB}}^{-}$	-1.531											35262
$M_{y_{OB}}^{+}$	-1.531									-4.829		-35262
$M_{x_{SB}}^{-}$		1.659							.128		6.329	-13342
$M_{x_{SB}}^{+}$		1.659					-3.023		.128		6.329	-12500
$M_{y_{SB}}^{-}$	-1.659							-.128		-4.829		-33978
$M_{y_{SB}}^{+}$	-1.659							-.128		-4.829		-33978
$M_{x_{OB}}$		8.18				6.521	-3.023		6.649		12.85	7348
$M_{y_{OB}}$	-8.18				-6.521			-6.649		-4.829		804

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS
CHECK					
APR					
APR					

H W LOUD MACHINE WORKS, INC.
887 EAST SECOND ST., POMONA, CALIFORNIA

15101
RYAN.
PAGE 41

Condition 38 2 pt Drift Outbd Wheel

	R_{xSB}	R_{ySB}	R_{zSB}	R_{xOB}	R_{yOB}	R_{zOB}	
	-2247	-15009	11921	-503	1537	1979	Σ
K'_{xSB}	.9825	-	.1860				9
R'_{ySB}	.0309	.9861	.1632				-12923
R'_{zSB}	.1834	-.1661	.9688				8644
K''_{xOB}				.9825	-	.1860	-126
R''_{yOB}				.0309	.9861	.1632	1823
R''_{zOB}				.1834	-.1661	.9688	1570

	K''_{xLB}	R'_{yLB}	R''_{xLB}	R'_{yLB}	R_{xSB}	R_{ySB}	R'_{zSB}	R_{xOB}	R_{yOB}	R''_{zOB}	R_T	Σ
	2234	21440	-1105	-14947	9	-12923	8644	-126	1823	1570	-1909	Σ
M_{xTA}^-		.93										19939
M_{xTA}^+		.93									5.60	9249
M_{yTA}^-	-.93											-2078
M_{yTA}^+	-.93											-2078
M_{xOB}^-		1.531									6.201	20986
M_{xOB}^+		1.531									6.201	20986
M_{yOB}^-	-1.531											-3420
M_{yOB}^+	-1.531									-4.829		-11002
M_{xSB}^-		1.659							.128		6.329	23720
M_{xSB}^+		1.659					-3.023		.128		6.329	-2411
M_{ySB}^-	-1.659							-.128		-4.829		-11272
M_{ySB}^+	-1.659							-.128		-4.829		-11272
M_{xLB}		8.18				6.521	-3.023		6.649		12.85	52567
M_{yLB}	-8.18				-6.521			-6.649		-4.829		-25077

			REVISED	DATE		
CALC	[illegible]				Main Gear	1310L
CHECK					Basic Loads	Ryan.
APR					H. W. LOUD MACHINE WORKS, INC. 887 East Second St., Pomona, California	PAGE 42.
APR						

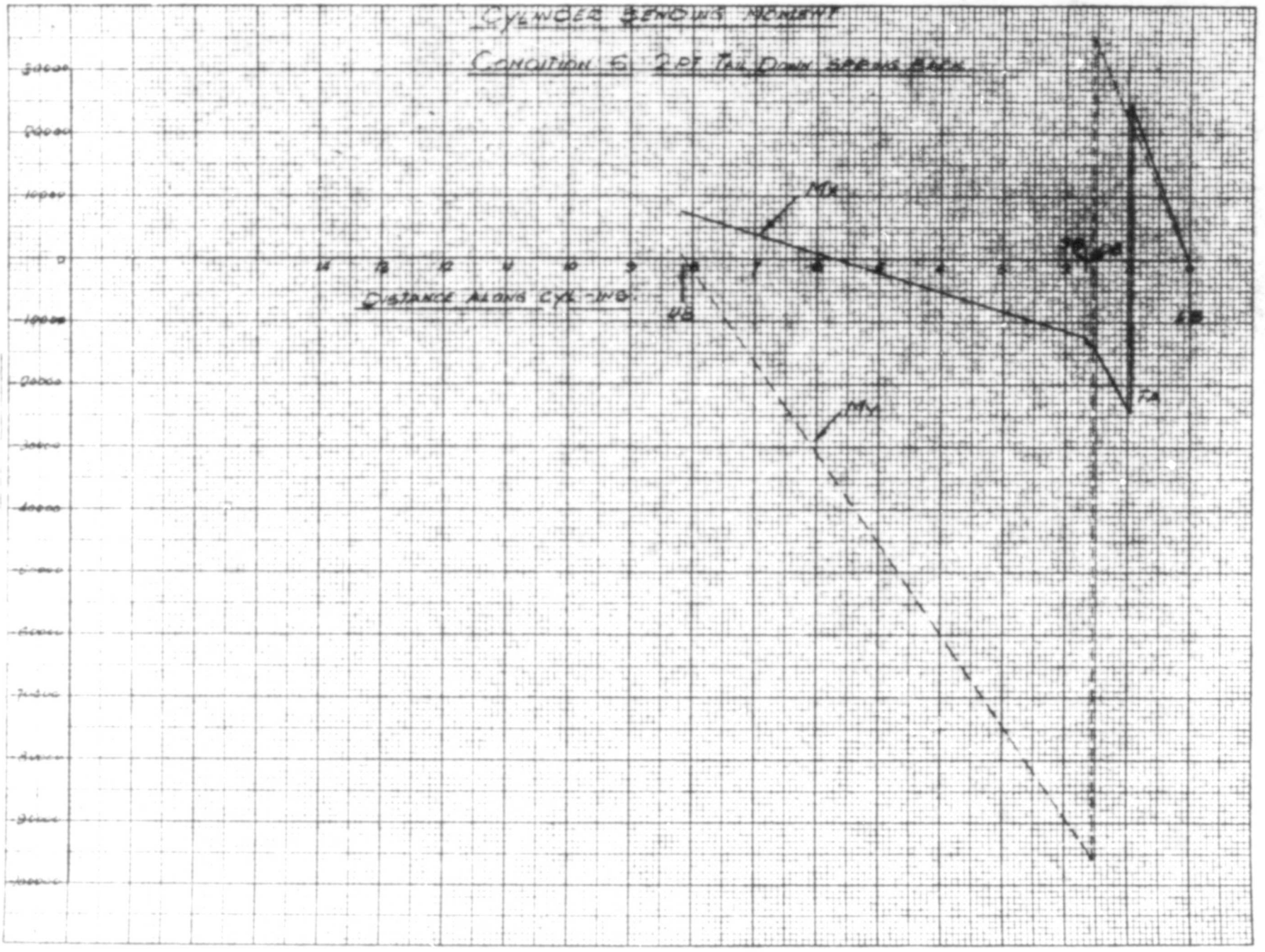
CONDITION 40 2PT BRAKED ROLL

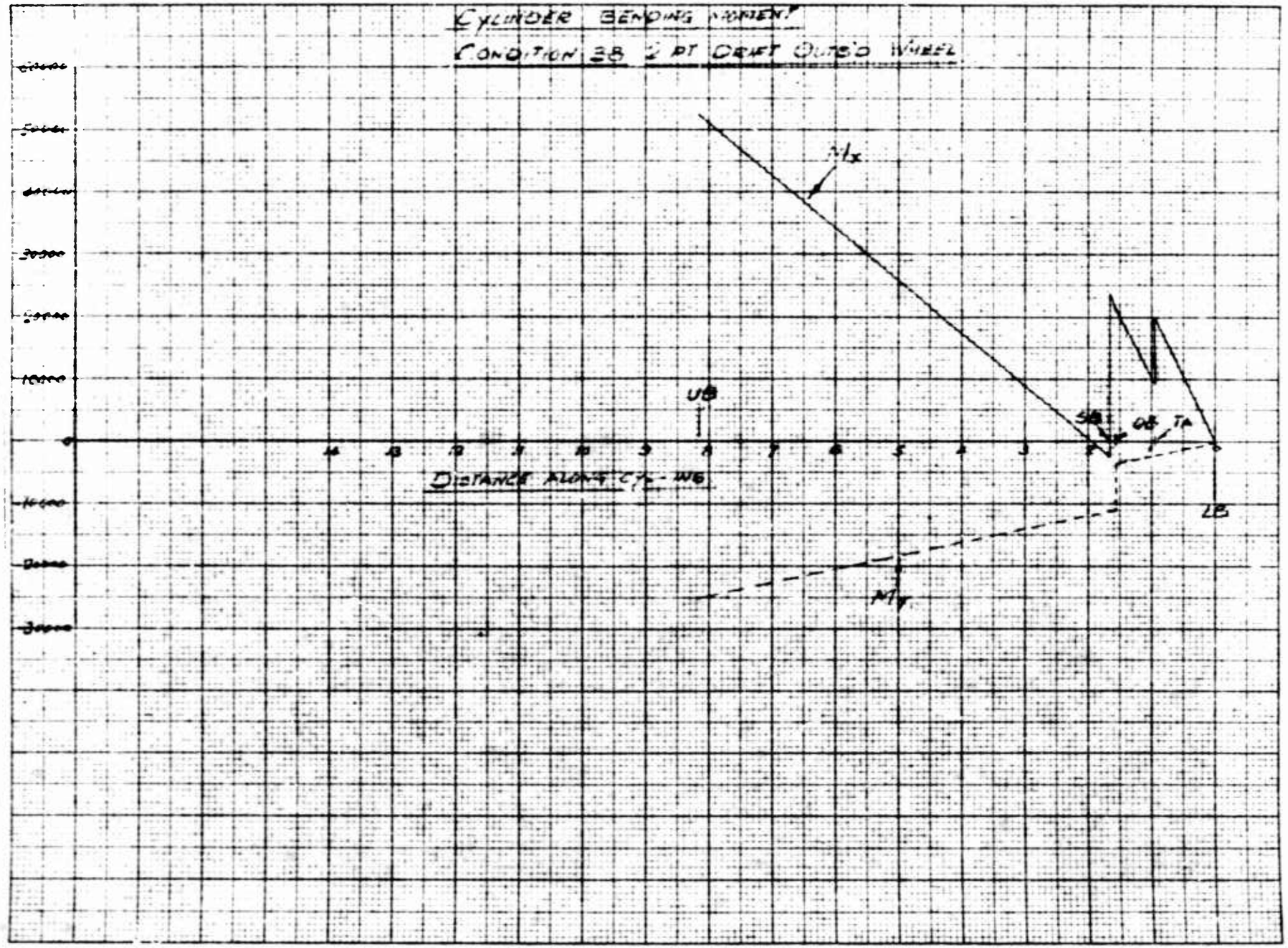
	R_{xSB}	R_{YSB}	R_{ZSB}	R_{xOB}	R_{YOB}	R_{ZOB}	
	1537	-10624	8449	-4400	5749	-6228	Σ
L_{xSB}	.9840	-	-.1782				6
R'_{xSB}	.0296	.9861	.1634				-3050
R'_{zSB}	.1757	-.1661	.9703				10233
R''_{xOB}				.9840	-	-.1782	-3220
R'_{YOB}				.0296	.9861	.1634	4514
R'_{zOB}				.1757	-.1661	.9703	-7770

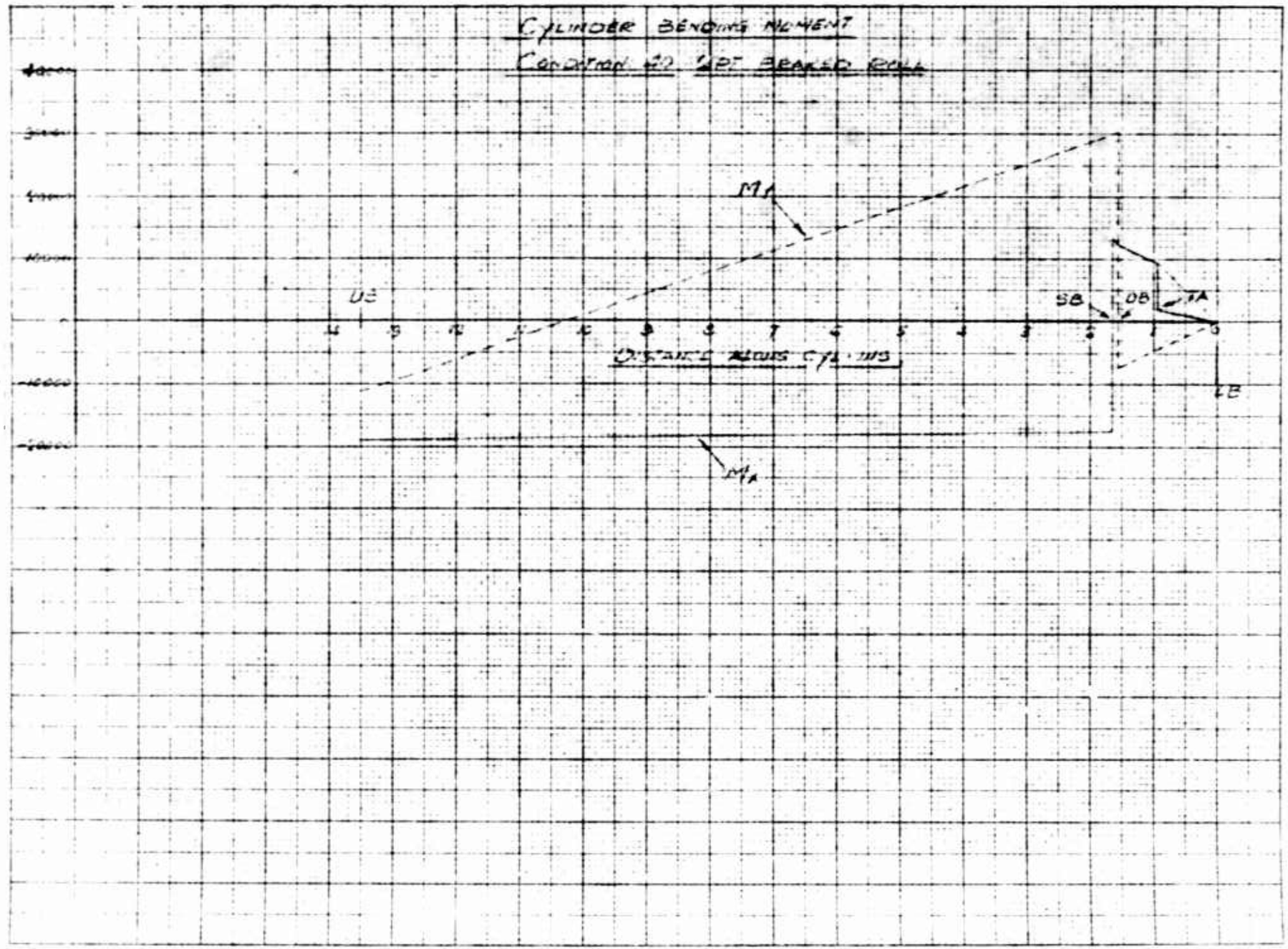
	R''_{xLG}	R'_{YLG}	R''_{xNG}	R'_{YNG}	R_{xSB}	R_{YSB}	R_{zSB}	R''_{xOB}	R'_{YOB}	R_{zOB}	R_T	
	4798	2095	-1400	-6883	6	-3050	10232	-3220	4514	-7770	2328	Σ
M_{xTA}^{-}		.93										1948
M_{xTA}^{+}		.93									3.27	9561
M_{yTA}^{-}	-.93											-4462
M_{yTA}^{+}	-.93											-4462
M_{xOB}^{-}		1.531									3.871	12219
M_{xOB}^{+}		1.531									3.871	12219
M_{yOB}^{-}	-1.531											-7346
M_{yOB}^{+}	-1.531									-1.829		30175
M_{xSB}^{-}		1.659							.128		3.999	13364
M_{xSB}^{+}		1.659					-3.023		.128		3.999	-17570
M_{ySB}^{-}	-1.659							-.128		-4829		29973
M_{ySB}^{+}	-1.659							-.128		-4829		29973
M_{xLG}		13.51				11.851	-3.023		11.979		15.85	-18911
M_{yLG}	-13.51				-11.851			-11.979		-4829		-11201

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS
CHECK					
APP					
APP					
					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA

1910L
RYAN.
PAGE 43


CYLINDER BENDING MOMENT
CONDITION 5: 2 DF TAIL DOWN BARING MANEUVER
DISTANCE ALONG CYL-INCHES
MX
MM
FA
FB


CYLINDER BENDING MOMENT
CONDITION 2B ½ PT DRIFT OUTSID WHEEL
M_x
UB
SB
OB
TA
LB
DISTANCE ALONG C/L - WB
M_y


CYLINDER BENDING MOMENT
CONDITION #2 UP BRAKED ROLL
MA
UB
SB
DB
TA
LB
DISTANCE ALONG CYLINDER
MB

PISTON BENDING MOMENTS

LANDING CONDITION

$M_{xo}^{-} = M_{xo}^{\cdot}$

$M_{yo}^{-} = M_{yo}^{\cdot}$

$M_{o}^{-} = M_{xo}^{\cdot} \longleftrightarrow M_{yo}$

$M_{xo}^{+} = M_{xo}^{\cdot} - 5.23\,R_T$

$M_{yo}^{+} = M_{yo}^{\cdot}$

$M_{o}^{+} = (M_{xo}^{\cdot} - 5.23 R_T) \longleftrightarrow M_{yo}^{\cdot}$

$M_{xLB} = 9.90\,Y_o^{\cdot} + M_{xo}^{\cdot} + 4.67\,R_T$

$M_{yLB} = -9.90\,X_o^{\cdot} + M_{yo}^{\cdot}$

$M_{LB}^{\cdot} = M_{xLB}^{\cdot} \longleftrightarrow M_{yLB}$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					BASIC LOADS	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 47
APR						

PISTON BENDING MOMENTS - CONT

GEAR FWD

LIMIT LOAD

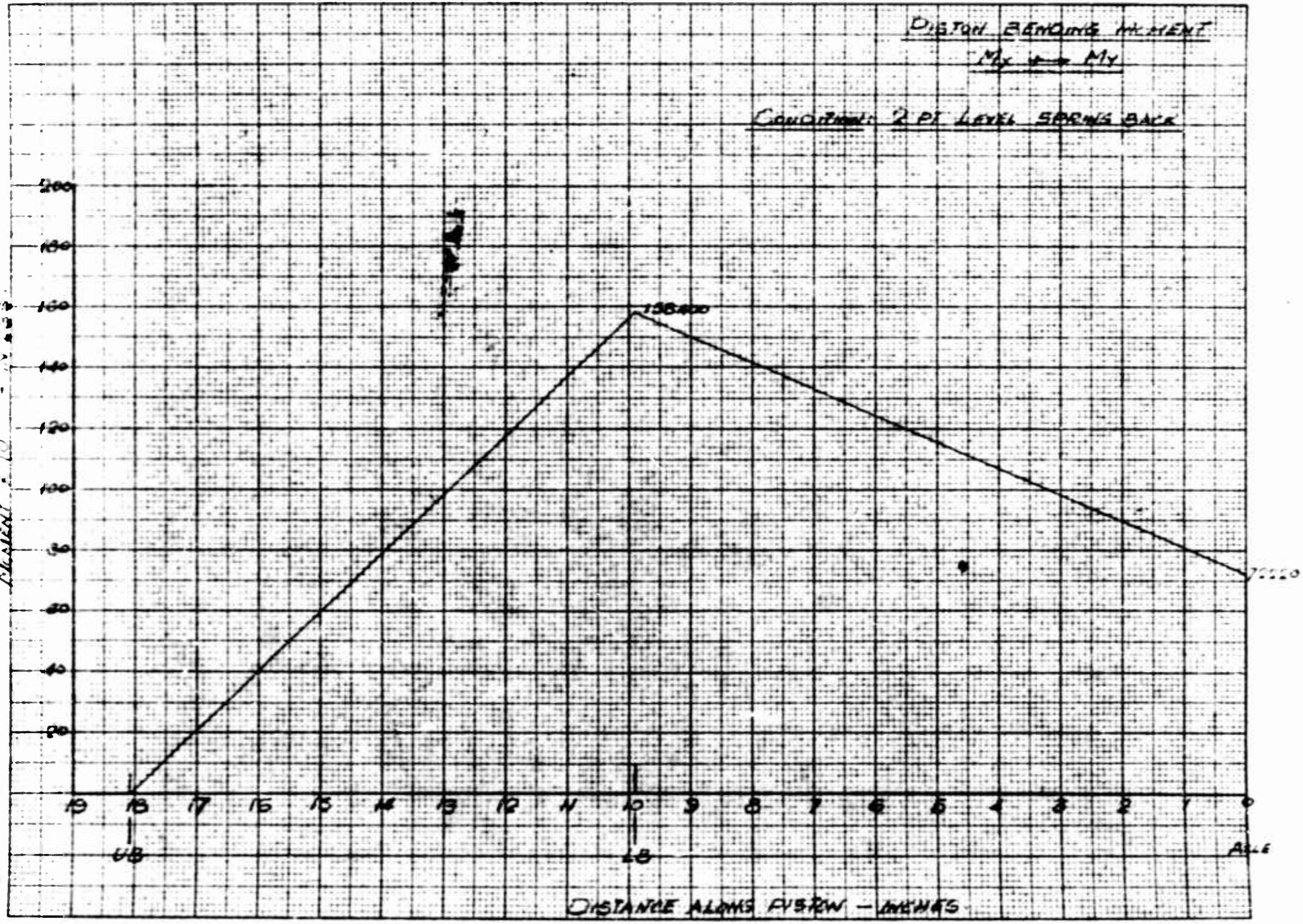
CONDITION 2PT LEVEL SPRING BACK

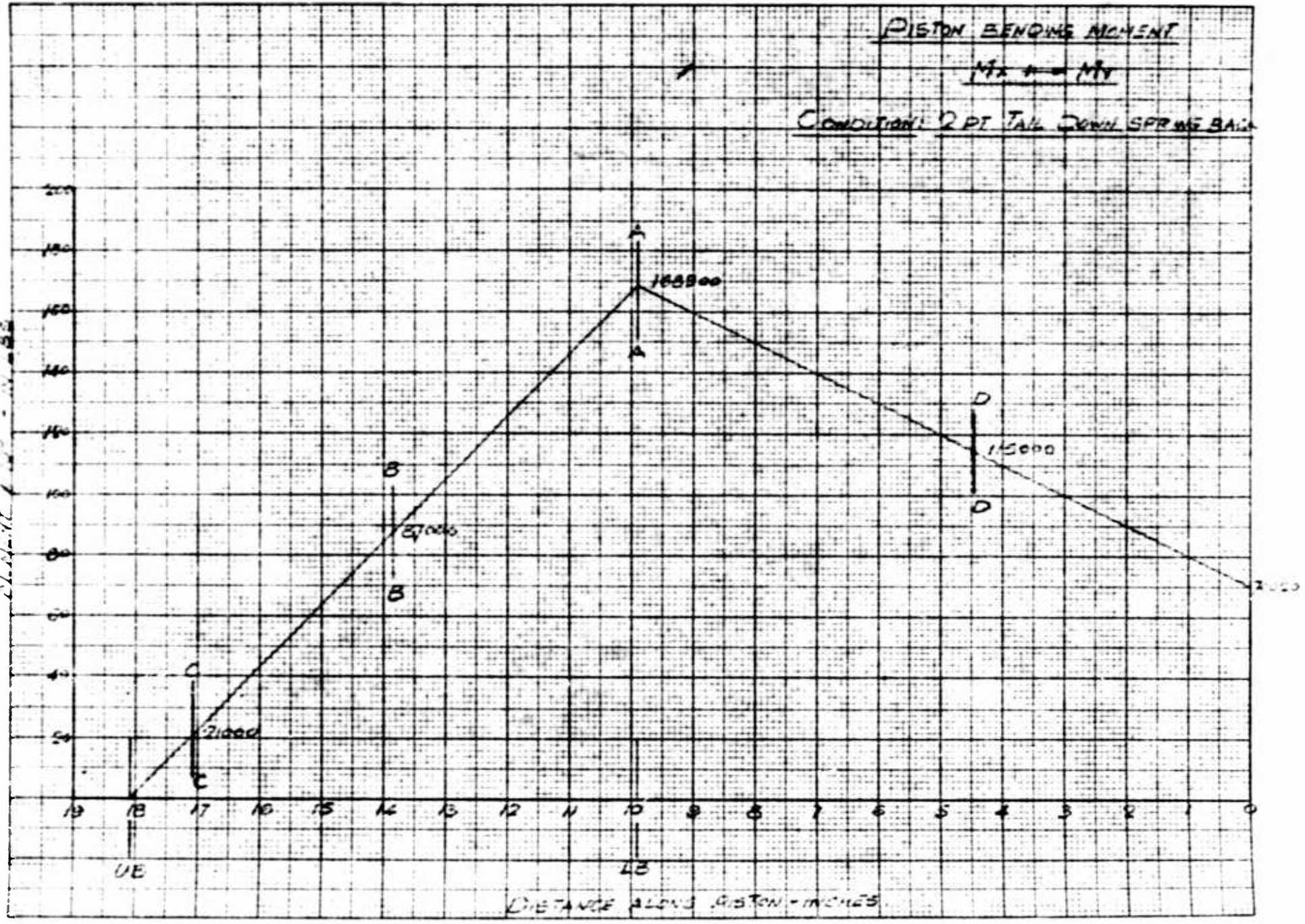
	X_o	Y_o	Z_o	M_{x_o}	M_{y_o}	M_{z_o}	R_T	
	-8640	1985	11784	71700	8611	51119	7688	Σ
M_{x_o} -				1.0				71700
M_{y_o} -					1.0			8611
M_{z_o} -								72920
M_{x_o} +				1.0			-5.23	31492
M_{y_o} +					1.0			8611
M_{z_o} +								32640
M_x LB		9.90		1.0			4.67	127259
M_y LB	-9.90				1.0			94147

CONDITION: 2PT TAIL DOWN SPRING BACK

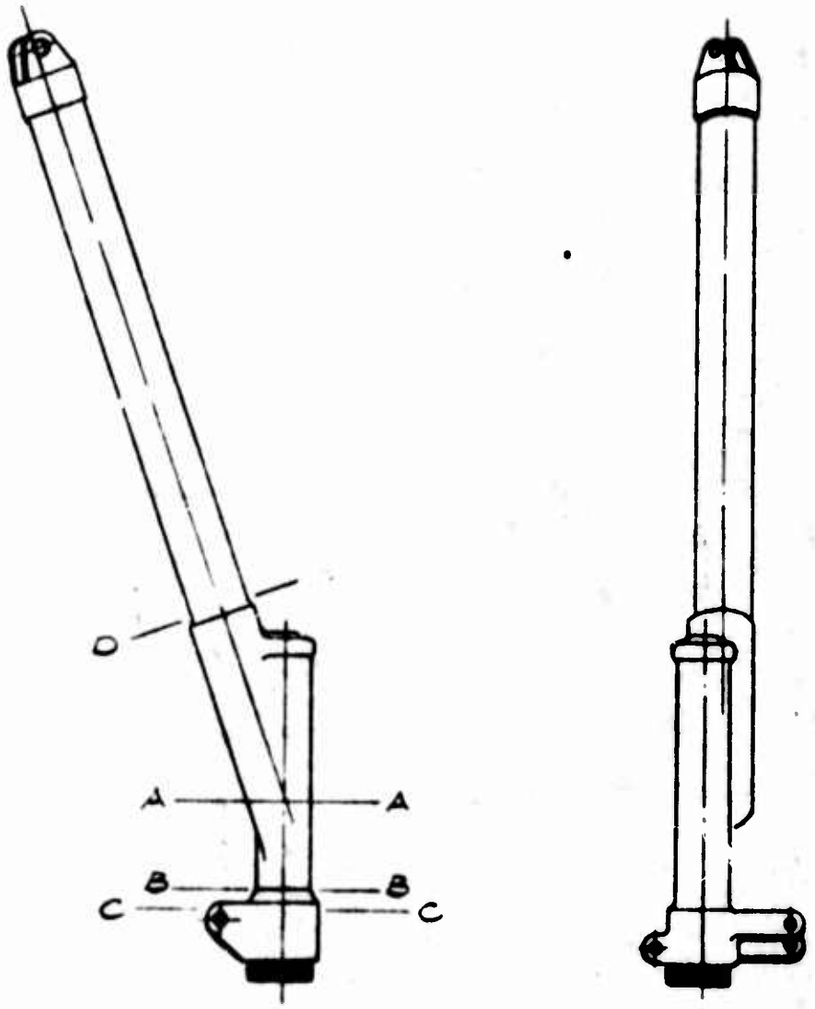
	X_o	Y_o	Z_o	M_{x_o}	M_{y_o}	M_{z_o}	R_T	
	-9876	1938	11508	70020	9842	58432	8788	Σ
M_{x_o} -				1.0				70020
M_{y_o} -					1.0			9842
M_{z_o} -								70720
M_{x_o} +				1.0			-5.23	24039
M_{y_o} +					1.0			9842
M_{z_o} +								26000
M_x LB		9.90		1.0			4.67	130286
M_y LB	-9.90				1.0			107614

CALC			REVISED	DATE	MAIN GEAR BASIC LOADS.	15106
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 48
APR						

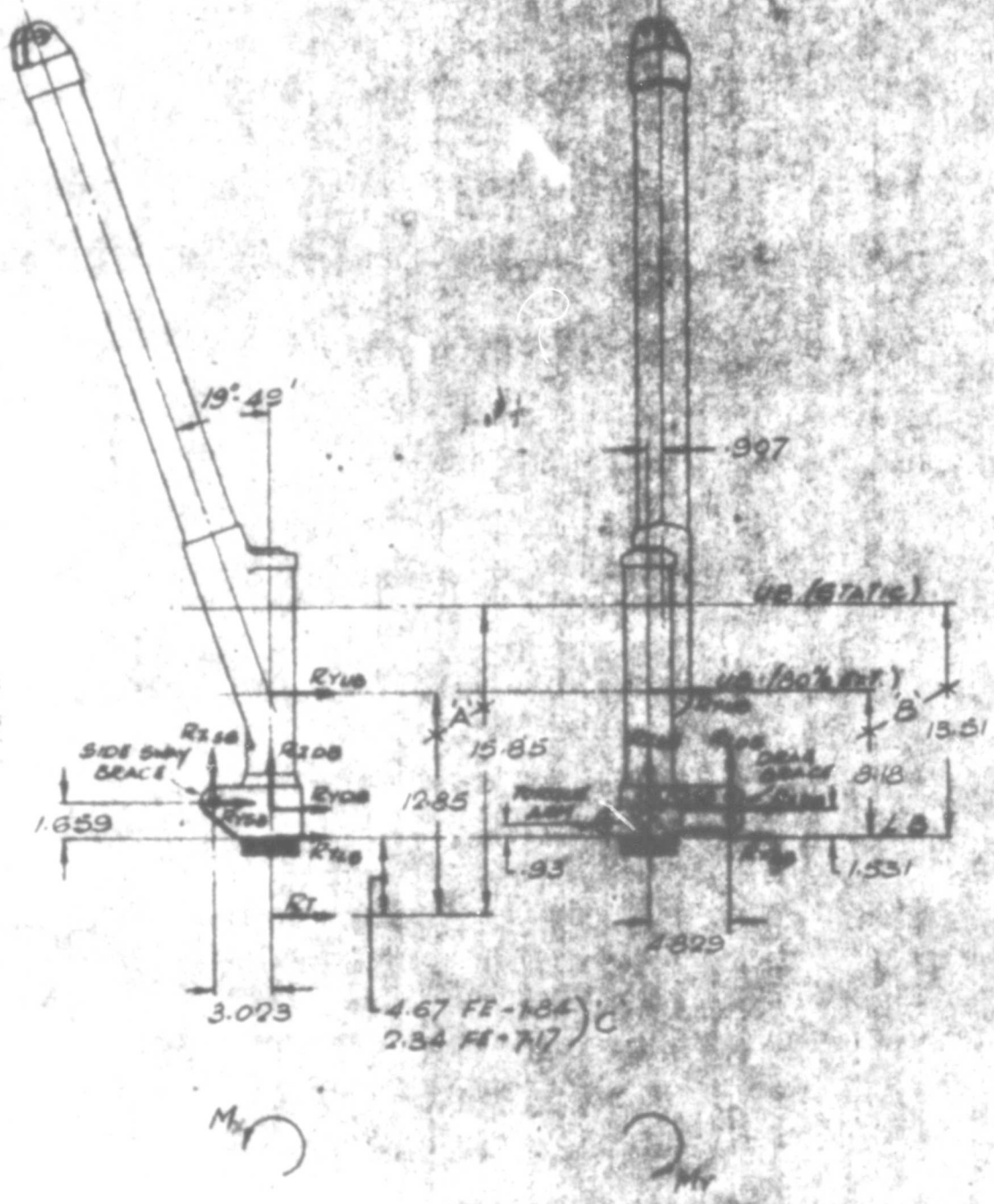

DISTRIBUTION BENDING MOMENT
M_x ⟷ M_y
CONDITION: 2 PT LEVEL SPRING BACK
MOMENT - 10^3 - INCH LBS
200
180
160
140
120
100
80
60
40
20
138400
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
UB
LB
AXLE
DISTANCE ALONG AXSTRW - INCHES


PISTON BENDING MOMENT
$M_x = M_y$
CONDITION: 2 PT TAIL DOWN SPRING BAR
A
168800
A
B
B
B
C
C
D
D
115000
UE
LB
DISTANCE ALONG PISTON - INCHES

7079-T6 ALUM
1510L144



CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APP						
APP					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 51



CALC			REVISED	DATE
CHECK				
APR				
APR				

MAIN GEAR CYLINDER

H. W. LOUD MACHINE WORKS, INC.
887 E. SECOND ST., POMONA, CALIFORNIA

15106
RYAN
PAGE 52.

SECTION A A (B-B above & L-B below) MAT'L 7079-T6

CONDITION 2g 2 OF DEPT OUTBD WHEEL

M_X = 52567 IN LBS
M_Y = -25077 IN LBS REF p 45

MAX BM = M_X ⟷ M_Y = 52567 ⟷ -25077 = 58230 IN LBS

COMPRESSION = $R'_{LB} + R'_{OB}$ = 8644 + 1570 = 10214 LBS REF p 42

SHEAR

$P_{SX} = R''_{XLB} + R''_{XSB} + R''_{XOB}$ = 2234 + 9 - 126 = 2117 LBS REF p 42

$P_{SY} = R''_{YLB} + R''_{YSB} + R''_{YOB}$ = 21440 - 12923 + 1823 = 10340 LBS

P_S = 2117 ⟷ 10340 = 10550 LBS

TORQUE

$R''_{XSB} \times 3.023 + R_{YOB} \times 4.829 + M_{Z_0}$

= 9 × 3.023 + 1823 × 4.829 + 12695 = 21525 IN LBS

AXIAL

Z''_0 = 6488 LBS REF p 37

PRESSURE

6488 / 5.922 = 1096 psi

CALC			REVISED	DATE	MAIN GEAR CYLINDER	SCL
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 53

SECTION A-A CONT

OD = 3.620	10.292	8.4296
ID = 3.063	7.360	4.3218
2t = .557	A = 2.923 IN²	I = 4.1078 IN⁴
t = .2785		

$O/t = 3.620/.2785 = 13.00$ $\quad Q = \frac{3.620^3 - 3.063^3}{12} = 1.559$

$F_{bu} = 71/74 \times 97000 = 93068$ psi

$F_{su} = 43000$ psi

$F_{tu} = 71000$ psi

$F_{cy} = 65000$ psi

$f_{bu} = \frac{39230 \times 1.50 \times 1.810}{4.1078} = 38486$ psi $\quad R_{bu} = \frac{38486}{93068} = .414$

$f_c = \frac{10214 \times 1.50}{2.923} = 5242$ psi $\quad R_c = \frac{5242}{65000} = .081$

$f_{tl} = \frac{1096 \times 1.50 \times 3.2415}{.557} = 9863$ psi $\quad R_{tl} = \frac{9863}{71000} = .139$

$f_{sl} = \frac{2.500 \times 1.50 \times 1.810}{8.2156} = 7113$ psi $\quad R_{sl} = \frac{7113}{43000} = .165$

$f_s = \frac{VQ}{Io} = \frac{18000 \times 1.559}{4.1078 \times .557} \times 1.50 = 10183$ psi $\quad R_s = \frac{11783}{43000} = .251$

$$M.S._{ult} = \frac{1}{R_c + [(R_b + R_t)^2 + (R_{tl})^2 + (R_s + R_{sl})^2]^{\frac{1}{2}}} - 1$$

$$= \frac{1}{.081 + [(.44)^2 + (.139)^2 + (.251 + .165)^2]^{\frac{1}{2}}} - 1$$

$$= \underline{4.63}$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1210L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 54
APR						

SECTION A A (8.18 ABOVE & LB. @ LB)

CONDITION 6 2 DT TAIL DOWN SPRING BACK - CRITICAL

M_X = 7348 IN LBS

M_Y = 804 IN LBS REF P 44

MAX BM = M_X +— M_Y = 7348 +— 804 = 7393 IN LBS

COMPRESSION

= $R_{Z'SB} + R_{Z'OB}$ = -276 + 27148 = 26872 LBS REF P 41

SHEAR

$P_{SX} = R_{X'LB} + R_{X'SB} + R_{X'OB}$ = 29052 + 23 + 8475 = -14534 LBS

$P_{SY} = R_{Y'LB} + R_{Y'SB} + R_{Y'OB}$ = 26645 + 245 - 15057 = 11833 LBS

P_S = -14534 +— 11833 = 18740 LBS

TORQUE

= $R_{X'SB} \times 3.023 + R_{Y'OB} \times 4.829 + M_{Z'O}$

= 23 × 3.023 - 15057 × 4.829 + 58432

= -14208 IN LBS

AXIAL

= Z'_O = 11508 LBS REF P 36

PRESSURE

= 11508/5.922 = 1943 PSI

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 55
APR						

SECTION AA · CONT.

O.D = 3.620 — 10.292 — 8.4296

I.D = 3.063 — 7.369 — 4.3218

2t = .557 — A = 2.923 IN² — I = 4.1078 IN⁴

t = .2785

$D/t = 3.620/.2785 = 13.00$ $\qquad Q = \frac{3.620^3 - 3.063^3}{12} = 1.559$

$F_{bu} = 71/74 \times 97000 = 93068$ psi

$F_{su} = 43000$ psi

$F_{hy} = 71000$ psi

$F_{cy} = 65000$ psi

$f_{bu} = \frac{7393 \times 1.50 \times 1.810}{4.1078} = 4886$ psi $\qquad R_{bu} = \frac{4886}{93068} = .052$

$f_c = \frac{26872 \times 1.50}{2.923} = 13790$ psi $\qquad R_c = \frac{13790}{65000} = .212$

$f_{ht} = \frac{1943 \times 1.50 \times 3.3415}{.557} = 17484$ psi $\qquad R_{ht} = \frac{17484}{71000} = .246$

$f_{sl} = \frac{14208 \times 1.50 \times 1.810}{8.2156} = 4695$ psi $\qquad R_{sl} = \frac{4695}{43000} = .109$

$f_s = \frac{18740 \times 1.559}{4.1078 \times .557} \times 1.50 = 19153$ psi $\qquad R_s = \frac{19153}{43000} = .445$

$$MS_{ULT} = \frac{1}{.212 + [(.052)^2 + (.246)^2 + (.445 + .109)^2]^{\frac{1}{2}}} - 1$$

$$= +.36$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 56
APR						

SECTION BB (4 1/2 ABOVE ℄ LB)

CONDITION 6 2 PT TAIL DOWN SPRING BACK - CRITICAL

M_X = -5000 IN LBS REF p 44

M_Y = -58500 IN LBS.

MAX BM = M_X ⟷ M_Y = -5000 ⟷ -58500 = 58970 IN LBS.

COMPRESSION

= $R_{Z'SB} + R_{Z'DB}$ = -276 + 27148 = 26872 LBS REF p 41

SHEAR

$P_{SX} = R_{X'LB} + R_{XSB} + R_{X'DB}$ = -23032 + 23 + 8475 = -14534 LBS

$P_{SY} = R_{YLB} + R_{YSB} + R_{Y'DB}$ = 26643 + 245 - 15057 = 11833 LBS

P_S = -14534 ⟷ 11833 = 18740 LBS

TORQUE

= $R_{X''SB} \times 3.023 + R_{YDB} \times 4.829 + M_{Z'D}$

= 23 × 3.023 - 15057 × 4.329 + 58492

= -14208 IN LBS

AXIAL

= Z'_S = 11508 LBS REF p 36

PRESSURE

= 11508 / 5.922 = 1943 psi

CALC			REVISED	DATE	MAIN GEAR CYLINDER	15106
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 57
APP						

SECTION B-B CONT

O.D. = 3.690	10.694	9.1007
I.D. = 3.063	7.369	4.9218
2t = .627	A = 3.325 IN²	I = 4.7789 IN⁴
t = .3135		

$O/t = 3.690/.3135 = 11.77$ $\quad Q = \frac{3.690^3 - 3.063^3}{12} = 1.793$

$F_{bu} = 71/74 \times 98000 = 94027$ psi

$F_{bL} = 43000$ psi

$F_{hu} = 71000$ psi

$F_{cy} = 65000$ psi

$f_{bu} = \frac{53970 \times 1.50 \times 1.845}{4.7789} = 34150$ psi $\quad R_{bu} = \frac{34150}{94027} = .363$

$f_c = \frac{26872 \times 1.50}{3.325} = 12123$ psi $\quad R_c = \frac{12123}{65000} = .187$

$f_{hf} = \frac{1943 \times 1.50 \times 3.3765}{.627} = 15695$ psi $\quad R_{hf} = \frac{15695}{71000} = .221$

$f_{sl} = \frac{14208 \times 1.50 \times 1.845}{9.5578} = 4114$ psi $\quad R_{sl} = \frac{4114}{43000} = .096$

$f_s = \frac{VQ}{Ib} = \frac{18740 \times 1.793}{4.7789 \times .627} \times 1.50 = 16821$ psi $\quad R_s = \frac{16821}{43000} = .391$

$$MS_{ULT} = \frac{1}{.187 + [(.363)^2 + (.221)^2 + (.391 + .096)^2]^{1/2}} - 1$$

$$= + 29$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 58
APR						

SECTION C-C (2.36 ABOVE ℄ LB)

CONDITION 6 LEFT TAIL DOWN SPRING BACK - CRITICAL

M_x = -10250 IN LBS
M_y = -84000 IN LBS
REF p 44

MAX BM = M_x ⟷ M_y = -10250 ⟷ -84000 = 84630 IN LBS.

COMPRESSION

= 26872 LBS REF p 55

SHEAR

= 18740 LBS. REF p 56

TORQUE

= -14208 IN LBS REF p 55

AXIAL

= 11508 LBS. REF p 55

PRESSURE

= 1943 psi. REF p 55

CALC	LB		REVISED	DATE	MAIN GEAR CYLINDER	15101
CHECK						RYAN.
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 59

SECTION C-C CONT.

O.D. = 3.930 — 12.130 — 11.7100

I.D. = 3.370 — 8.920 — 6.3312

2t = .560 — A = 3.210 in² — I = 5.3788 in⁴

t = .280

$D/t = 3.930/.280 = 14.04$ $\qquad Q = \frac{3.930^3 - 3.370^3}{12} = 1.869$

$F_{bu} = 71/74 \times 96000 = 92108$ psi

$F_{su} = 43000$ psi

$F_{tu} = 71000$ psi

$F_{cy} = 65000$ psi

$f_{bu} = \frac{84630 \times 1.50 \times 1.965}{5.3788} = 46376$ psi $\qquad R_{bu} = \frac{46376}{92108} = .503$

$f_c = \frac{26872 \times 1.50}{3.210} = 12557$ psi $\qquad R_c = \frac{12557}{65000} = .193$

$f_{ht} = \frac{1943 \times 1.50 \times 3.650}{.560} = 18996$ psi $\qquad R_{ht} = \frac{18996}{71000} = .268$

$f_{st} = \frac{14208 \times 1.50 \times 1.965}{10.76,6} = 3893$ psi $\qquad R_{st} = \frac{3893}{43000} = .091$

$f_s = \frac{18740 \times 1.869}{5.3788 \times .560} \times 1.50 = 17442$ psi $\qquad R_s = \frac{17442}{43000} = .406$

$$M.S._{ULT} = \frac{1}{.193 + [(.503)^2 + (.268)^2 + (.406 + .091)^2]^{1/2}} - 1$$

$$= +.11$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 807 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 60
APR						

SECTION O O (30.50 BELOW UPPER ATTMT)

CONDITION 37. ½ PT DRIFT INBD WHEEL GEAR AFT CRITICAL

$X'' = .9825(53) + .1860(-399) = 22$

$Y'' = .0309(53) + .3861(-721) + .1632(-389) = -774$

$Z'' = .1834(.53) - .1661(-721) + .9668(-399) = -257$

REF p 34

$\cos 19°49' = .9408$

$\sin 19°49' = .3390$

$Z'' = Z\cos - Y\sin$

$Y'' = Z\sin + Y\cos$

$X'' = 22$

$Y'' = -257(.339) - 774(.9408) = -815$

$Z'' = -267(.9408) + 774(.339) = 20$

$p = 3000$ psi

$P_c = -1186$ LB. COMP.

AXIAL LOAD DUE TO AIR PRESSURE = 5000 × AREA 2.485 DIA

= 5000 × 4.889 = 24445 LB TENSION

NET AXIAL LOAD = 24445 - (1186 × 1.50) = 22666 LB. COMP.

SHEAR

= 22 ⟷ -815 = 815 LB.

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 087 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 61
APR						

SECTION 0.0 CONT.

MOMENT = 22 × 30.5 ⟵ + ⟶ 815 × 30.5 = 24570 IN LBS

0.0 = 2.770	6.026	2.8899
1.0 = 2.430	4.638	1.7116
2t = .340	A = 1.388 IN²	I = 1.1783 IN⁴
t = .170		

$D/t = 2.770/.170 = 16.29$ $\qquad Q = \frac{2.770^3 - 2.430^3}{12} = .575$

$F_{bu} = 71/74 \times 95000 = 91149$ psi

$F_{cy} = 65000$ psi (ALLOWABLE FOR SHORT COLUMN = 58905 psi)

$F_{tu} = 71000$ psi

$F_{su} = 43000$ psi

$f_b = \frac{24870 \times 1.50 \times 1.385}{1.1783} = 43849$ psi $\qquad R_{bu} = \frac{43849}{91149} = .481$

$f_c = \frac{22666}{1.388} = 16330$ psi $\qquad R_c = \frac{16330}{58905} = .277$

$f_{tl} = \frac{5000 \times 2.60}{.340} = 38235$ psi $\qquad R_{tl} = \frac{38235}{71000} = .539$

$f_s = \frac{VQ}{Ib} = \frac{815 \times .575}{1.1783 \times .340} \times 1.50 = 1755$ psi $\qquad R_s = \frac{1755}{43000} = .041$

$$MS_{ULT} = \frac{1}{.277 + [(.481)^2 + (.539)^2 + (.041)^2]^{1/2}} - 1$$

$$= .00$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	15101
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 62
APR						

CHECK of THREADED PORTION of LOWER CYL BARREL

LOADING CONDITIONS

F.C AIR PRESSURE = 1816 psi
F.E AIR PRESSURE = 126 psi
UNSPRUNG WEIGHT = 51 LBS.

1 LOAD DUE TO F.C AIR PRESSURE ACTING BETWEEN CYLINDER O/D & PISTON O/D

$P = 1816 \times 1.50 (.7854 \times 3.370^2 - 2.746^2) = 8172$ LBS.

2 THREE TIMES F.E. AIR PRESSURE ACTING ON CYLINDER O/D.

$P = 126 \times 3 \times 1.50 (.7854 \times 3.370^2) = 565$ LBS.

3. TWENTY TIMES UNSPRUNG WEIGHT

$P = 20 \times 51 = 1020$ LBS.

CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER.	15101
CHECK						RYAN.
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 62
APP						

THREADED PORTION of LOWER CYL. BARREL - CONT.

TENSION @ RELIEF GROOVE

LOADING CONDITION 1 CRITICAL = 8172 LBS. REF p 63

THREAD = 3.875 - 16 UN - 3A

RELIEF GROOVE = 3.770 MIN DIA.

CYLINDER BORE = 3.370 MAX DIA

AREA = 11.163 - 8.920 = 2.243 IN.²

$f_h = \frac{8172}{2.243} = 3643$ psi

$F_h = 71000$ psi

$MS_{ULT} = \frac{71000}{3643} - 1 = +$ LARGE

SHEAR ACROSS THREADS.

PITCH DIA. of THREAD = 3.8300 MIN.

MIN LENGTH of THREAD = .730 INS.

$f_{sw} = \frac{8172}{3.8300 \times .730/2 \times \pi} = 1860$ psi

$F_{sw} = 43000$ psi

$MS_{ULT} = \frac{43000}{1860} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1610L
CHECK						
APR						RYAN.
APR					H. W. LOUD MACHINE WORKS, INC. 827 East Second St., Pomona, California	PAGE 64

CHECK of THREADED PORTION of UPPER CYL (RESERVOIR)

RESERVOIR BURST PRESSURE = 2.20 × 3000 = 6600 psi

CYLINDER I/D = 2.495 AREA = 4.889 IN²

LOAD = 6600 × 4.889 = 32267 LBS

TENSION @ RELIEF GROOVE

THREAD : 2.75 - 16 UN - 3B

RELIEF GROOVE = 2.780 MAX. DIA

CYLINDER O/D = 3.113 MIN.

AREA = 7.621 - 6.070 = 1.551

$$f_{tu} = \frac{32267}{1.551} = 20804 \text{ psi}$$

$F_{tu} = 71000$ psi

$$MS_{ULT} = \frac{71000}{20804} - 1 = \underline{+ \text{LARGE}}$$

SHEAR ACROSS THREADS

PITCH DIA. of THREAD = 2.7148 MAX

MIN. LENGTH of THREAD = .41 INS.

$$f_{su} = \frac{32267}{2.7148 \times .41/2 \times \pi} = 18454 \text{ psi} \qquad F_{su} = 43000 \text{ psi}$$

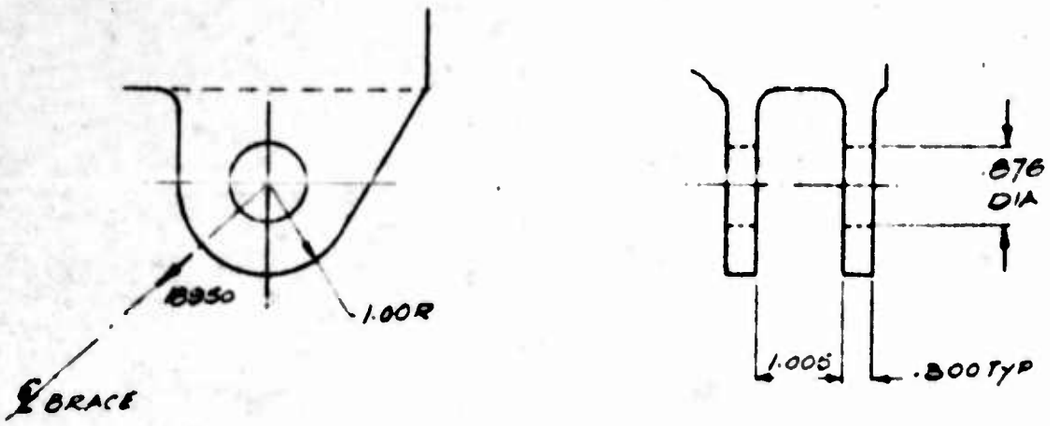
$$MS_{ULT} = \frac{43000}{18454} - 1 = \underline{+ \text{LARGE}}$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 65.
APR						

SIDE BRACE ATTACH^MT LUG

CONDITION: 2 2PT LEVEL SPIN UP. CRITICAL

P(0-2) = 18950 LBS LIMIT



ASSUMING 18950 LB LOAD IS AXIAL

TENSION

$P'_{tu} = K_t F_{tu} A_t$

W = 2.00

D = .876

T = .30

$W/D = 2.00/.876 = 2.28 \quad \therefore K_t = .95$

$A_t = (2.00 - .876) \times .30 \times 2 = .674$

$F_{tu} = 71000$ psi

$P'_{tu} = .95 \times 71000 \times .674 = 45461$ LBS.

$$MS_{ULT} = \frac{45461}{18950 \times 1.50 \times 1.15} - 1 = +.39$$

(1.15 = FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 66
APR						

5.08 BRACE ATTACH MT LUG - CONT

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

$a = 1.00$

$D = .876$

$T = .30$

$a/D = 1.00/.876 = 1.14 \quad \therefore K_{br} = .97$

$$A_{br} = .876 \times .30 \times 2 = .526$$

$F_{tu} = 71000$ psi

$$P'_{bru} = .97 \times 71000 \times .526 = 36226 \text{ LBS}$$

$$M.S._{ULT} = \frac{36226}{18950 \times 1.50 \times 1.15} - 1 = +.11$$

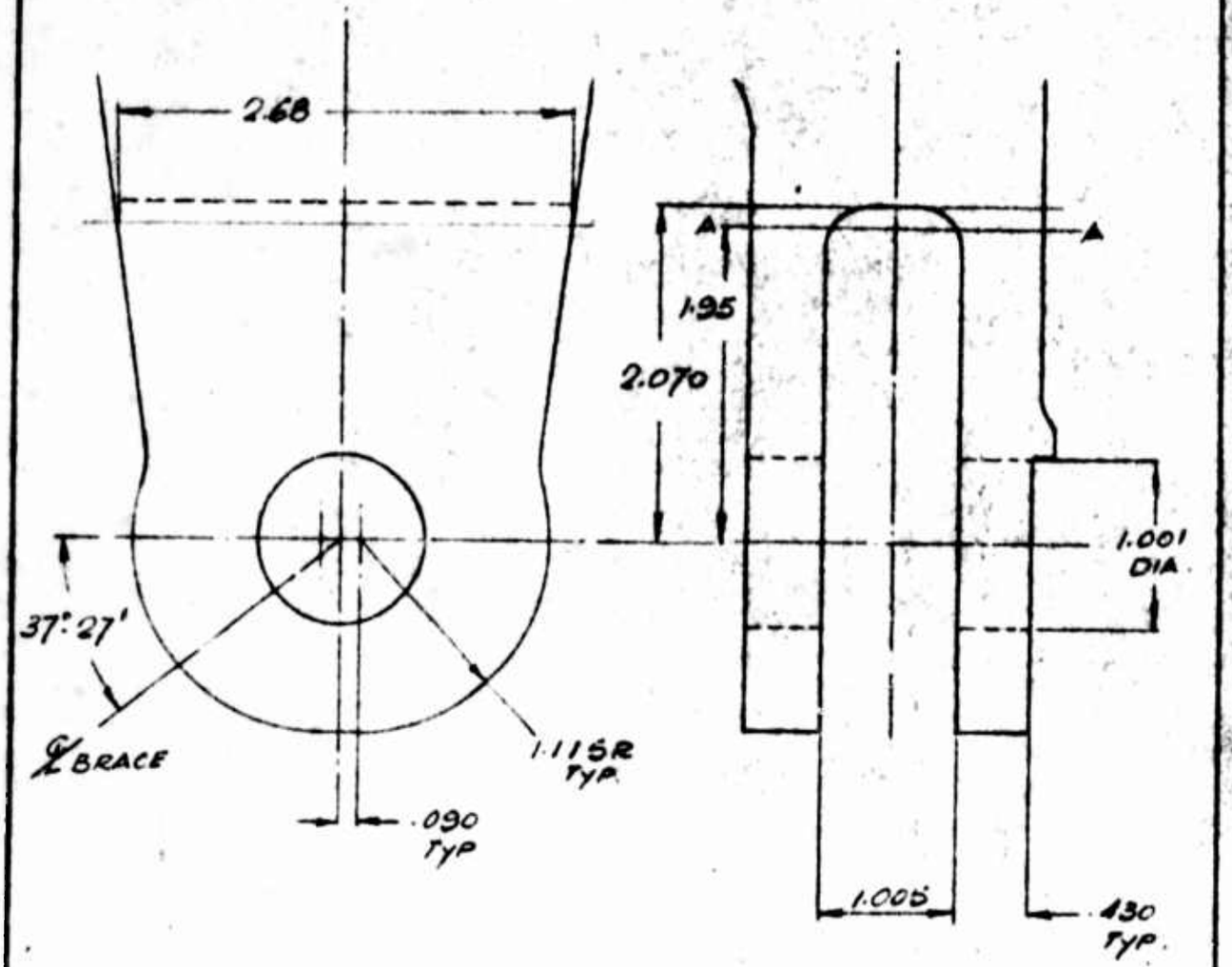
(1.15 = FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1610L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 67
APR						

DRAG STRUT ATTACH^{MT} LUG

CONDITION 6 2 PT TAIL DOWN SPRING BACK CRITICAL

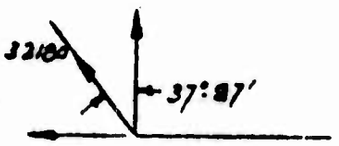
P(0-3) = 32180 LBS LIMIT.



CALC			REVISED	DATE	MAIN GEAR CYLINDER	15106
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 68
APR						

DRAG STRUT ATTACH^MT LUG CONT.

SECTION A-A



Cos 37°27' = .7939

Sin 37°27' = .6081

M = 32180 × .7939 × 1.95 = 49818 IN LBS

PER LUG = 49818/2 = 24909 IN LBS

AREA = 2.68 × .43 = 1.152 IN.²

$I = \frac{.43 \times 2.68^3}{12} = .6898$ IN.⁴ K = 1.50

$F_{bu} = 71/74 \times 105000 = 100743$ psi

$F_{tu} = 71000$ psi

$F_{su} = 43000$ psi

$f_{bu} = \frac{24909 \times 1.50 \times 1.34}{.6898} = 72582$ psi $R_{bu} = \frac{72582}{100743} = .720$

$f_{su} = \frac{32180 \times .7939 \times 1.50}{1.152 \times 2} = 16633$ psi $R_{su} = \frac{16633}{43000} = .387$

$f_{tu} = \frac{32180 \times .6081 \times 1.50}{1.152 \times 2} = 12740$ psi $R_{tu} = \frac{12740}{71000} = .179$

$$MS_{ULT} = \frac{1}{(.720 \times .179) + .387} - 1 = +.02$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER.	15101
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 69.

DRAG STRUT ATTACHMT LUG - CONT

ASSUMING 32180-3 LOAD IS AXIAL

TENSION

$$P'_{tu} = K_t F_{tu} A_t$$

$W = (1.115 + .090) \times 2 = 2.410$

$D = 1.001$

$T = .430$

$$W/D = 2.410/1.001 = 2.41 \quad \therefore K_t = .94$$

$$A_t = (2.410 - 1.001) \times .430 \times 2 = 1.212$$

$F_{tu} = 71000$ psi

$$P'_t = .94 \times 71000 \times 1.212 = 80889 \text{ LBS}$$

$$MS_{ULT} = \frac{80889}{32180 \times 1.50 \times 1.15} - 1 = \underline{+.46}$$

(1.15 = FITTING FACTOR)

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tux} A_{br}$$

$a = 1.115$

$D = 1.001$

$T = .430$

$$a/D = 1115/1.001 = 1.115 \quad \therefore K_{br} = .96$$

$$A_{br} = 1.001 \times .43 \times 2 = .861$$

$F_{tux} = 71000$ psi

$$P'_{bru} = .96 \times 71000 \times .861 = 58686 \text{ LBS}$$

$$MS_{ULT} = \frac{58686}{32180 \times 1.50 \times 1.15} - 1 = \underline{+.06}$$

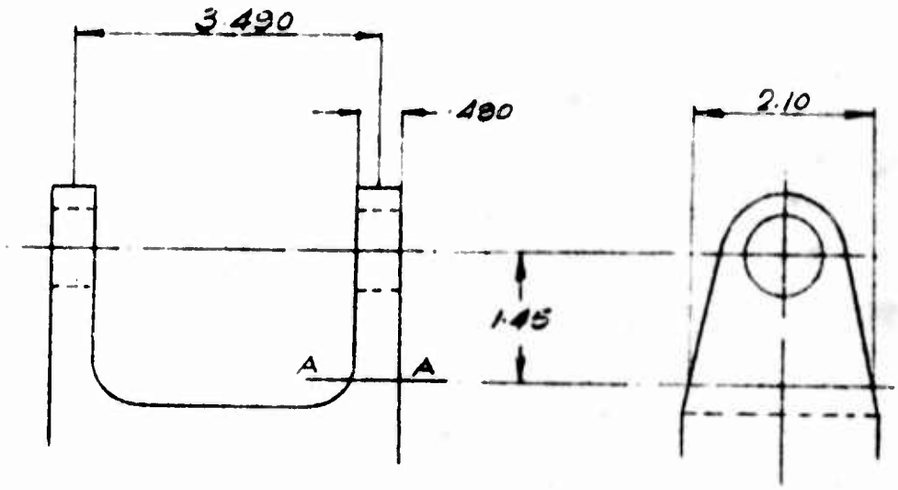
CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 70

CYLINDER ATTACH MT LUG

CONDITION 6 20° TAIL DOWN SPRING BACK - CRITICAL

$P(0-1) = -39117$ LBS LIMIT

$T(1) = 8768$ IN LBS LIMIT.



SECTION A-A

$$M = \frac{8768 \times 1.45}{3.49} = 3643 \text{ IN LBS}$$

$$\text{AREA} = 2.10 \times .490 = 1.029 \text{ IN}^2$$

$$I = \frac{.490 \times 2.10^3}{12} = .3782 \text{ IN}^4 \qquad K = 1.50$$

$F_{bu} = 71/74 \times 105000 = 100743$ psi

$F_{cy} = 65000$ psi

$F_{su} = 43000$ psi

CALC	[illegible]		REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 71
APR						

SECTION A-A - CONT.

$f_{bu} = \frac{3643 \times 1.50 \times 1.05}{.3782} = 15171$ psi $R_{bu} = \frac{15171}{100743} = .151$

$f_{cy} = \frac{39117 \times 1.50}{2 \times 1.029} = 28511$ psi $R_{cy} = \frac{28511}{65000} = .439$

$f_{su} = \frac{8768 \times 1.50}{3.49 \times 1.029} = 3662$ psi $R_{su} = \frac{3662}{43000} = .085$

$$MS_{ULT} = \frac{1}{(.151 \longleftrightarrow .085) + .439} - 1 = +.63$$

TO FIND THICKNESS OF LUG TO GIVE $MS_{ULT} = 0$

ASSUME CR DISTANCE BETWEEN LUGS = 3.30 & LUG THICKNESS .30

$M = \frac{8768 \times 1.45}{3.30} = 3853$

AREA = $2.10 \times .30 = .63$ $I = \frac{.30 \times 2.10^3}{12} = .2315$

$f_{bu} = \frac{3853 \times 1.50 \times 1.05}{.2315} = 26214$ psi $R_{bu} = \frac{26214}{100743} = .260$

$f_{cy} = \frac{39117 \times 1.50}{2 \times .63} = 46568$ psi $R_{cy} = \frac{46568}{65000} = .716$

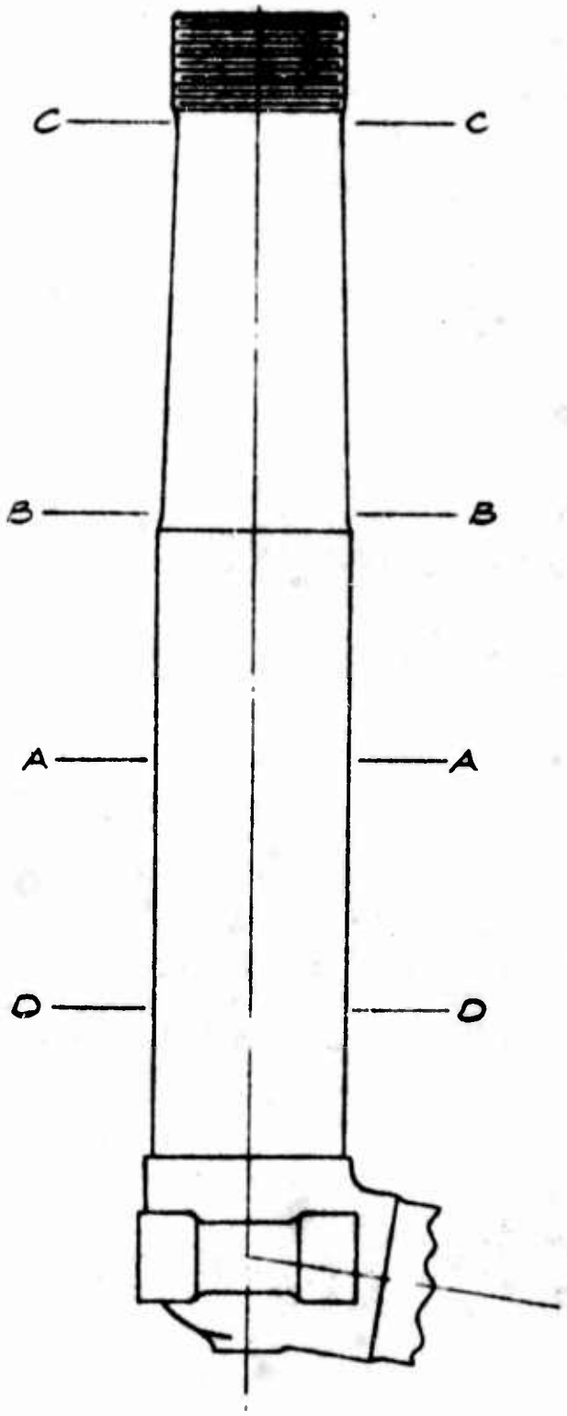
$f_{su} = \frac{8768 \times 1.50}{3.30 \times .63} = 6326$ psi $R_{su} = \frac{6826}{43000} = .147$

$$MS_{ULT} = \frac{1}{(.260 \longleftrightarrow .147) + .716} - 1 = .00$$

CALC			REVISED	DATE	MAIN GEAR CYLINDER	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 72

STEEL 260/280 KSI

1510L 140



CALC			REVISED	DATE	MAIN GEAR PISTON	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 73
APR						

SECTION A A (AT ℄ LOWER BEARING) FE - 1.84 INS

CONDITION 2 PT TAIL DOWN SPRING BACK - CRITICAL

M'_{LB} = 168900 IN LBS - REF ϕ 50

$P_C = Z'_o$ = 11508 LBS. - REF ϕ 36

$P_S = (Y'_o + R_T) \longleftrightarrow X'_o$ = 14580 LBS - REF ϕ 36

MAT'L 4340 STEEL
260/280 KSI

OD = 2.740	5.896	2.7668
ID = 2.404	4.539	1.6399
$2t$ = .336	A = 1.357 IN.^{2}	I = 1.1269 IN.^{4}
t = .168		

$O/t = 2.740/.168 = 16.31$

$Q = \frac{2.740^3 - 2.404^3}{12} = .557$

F_{bu} = 325000 psi

F_{cy} = 242000 psi

F_{su} = 149000 psi

$f_{bu} = \frac{168900 \times 1.50 \times 1.370}{1.1269} = 308000$ psi $\quad R_{bu} = \frac{308000}{325000} = .948$

$f_c = \frac{11508 \times 1.50}{1.357} = 12721$ psi $\quad R_c = \frac{12721}{242000} = .052$

$f_s = \frac{VQ}{Ib} = \frac{14580 \times .557}{1.1269 \times .336} \times 1.50 = 32172$ psi $\quad R_s = \frac{32172}{149000} = .216$

$MS_{ULT} = \frac{1}{(.948 + .052)} - 1 = \frac{+.00}{\text{(COMP FIBER)}}$

CALC			REVISED	DATE	MAIN GEAR PISTON	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 74
APR						

SECTION B-B (4.23 BELOW UPPER BEARING) FE - 1.84 INS

CONDITION: 2 PT TAIL DOWN SPRING BACK - CRITICAL

M_{LB} = 87000 IN LBS. - REF p 50

$P_c = Z_o$ = 11508 LBS - REF p 36

$P_s = R_{LB}$ = 20650 LBS - REF p 36

OD = 2.615	5371	2.2955
ID = 2404	4539	16399
2t = .211	A = .832 IN^2	I_o = .6556 IN^4
t = .1055		

$O/t = 2.615/.1055 = 24.79$ $\qquad Q = \frac{2.615^3 - 2.404^3}{12} = .333$

F_{bu} = 306000 psi

F_{cy} = 242000 psi

F_{su} = 149000 psi

$f_{bu} = \frac{87000 \times 1.50 \times 1.3075}{.6556} = 260263$ psi $\qquad R_{bu} = \frac{260263}{306000} = .851$

$f_c = \frac{11508 \times 1.50}{.832} = 20748$ psi $\qquad R_c = \frac{20748}{242000} = .086$

$f_{su} = \frac{VQ}{Ib} = \frac{20650 \times .333}{.6556 \times .211} \times 1.50 = 74563$ psi $\qquad R_s = \frac{74563}{149000} = .500$

$$MS_{ULT} = \frac{1}{.851 + .086} - 1 = +.067 \text{ (COMP FIBER)}$$

CALC			REVISED	DATE	MAIN GEAR PISTON	1510 L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 75
APR						

SECTION C-C (1.0 BELOW UPPER BEARING) FE-1.84

CONDITION: 2 PT TAIL DOWN SPRING BACK - CRITICAL

M_{LB} = 21000 IN LBS — REF p. 50

$P_c = Z'_o$ = 11508 LBS — REF p. 36

$P_s = R'_{LB}$ = 20650 LBS. — REF p. 36

O.D. = 2.520

I.D. = 2.404

$2t$ = .116

t = .058

4.988 − 4.539 = A = .449 IN²

1.9796 − 1.6399 = I = .3397 IN⁴

D/t = 2.520/.058 = 43.45

$Q = \frac{2.520^3 - 2.404^3}{12} \cdot .176$

F_{bu} = 256000 psi

F_{cy} = 242000 psi

F_{su} = 149000 psi

$f_{bu} = \frac{21000 \times 1.50 \times 1.260}{.3397}$ = 116838 psi $\quad R_{bu} = \frac{116838}{256000}$ = .456

$f_c = \frac{11508 \times 1.50}{.449}$ = 38446 psi $\quad R_c = \frac{38446}{242000}$ = .159

$f_{su} = \frac{VQ}{Ib} = \frac{20650 \times .176}{.3397 \times .116} \times 1.50$ = 138347 psi $\quad R_s = \frac{138347}{149000}$ = .929

$M.S_{ULT} = \frac{1}{.456 + .159} - 1 = \underline{+.63}$ (COMBO FIBER)

$M.S_{SHEAR} = \frac{1}{.929} - 1 = \underline{+.08}$

CALC			REVISED	DATE	MAIN GEAR PISTON	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 76
APR						

SECTION O-O (5.43 BELOW LOWER BEARING) FE-1.84 INS.

CONDITION. 2 PT TAIL DOWN SPRING BACK - CRITICAL

M'_{LB} = 115000 IN LBS -- REF p. 50

$P_C = Z'_o$ = 11508 LBS — REF p. 36

$P_S = (Y'_o + R_T) \longleftarrow X'_o$ = 14580 LBS — REF p. 36

OO = 2.740	5.896	2.7668
IO = 2.460	4.753	1.7977
2t = .280	A = 1.143 IN²	I = .9691 IN⁴
t = .140		

$O/t = 2.740/.140 = 20.65$ $\qquad Q = \frac{2.740^3 - 2.460^3}{12} = .473$

F_{bu} = 310000 psi

F_{cy} = 242000 psi

F_{su} = 149000 psi

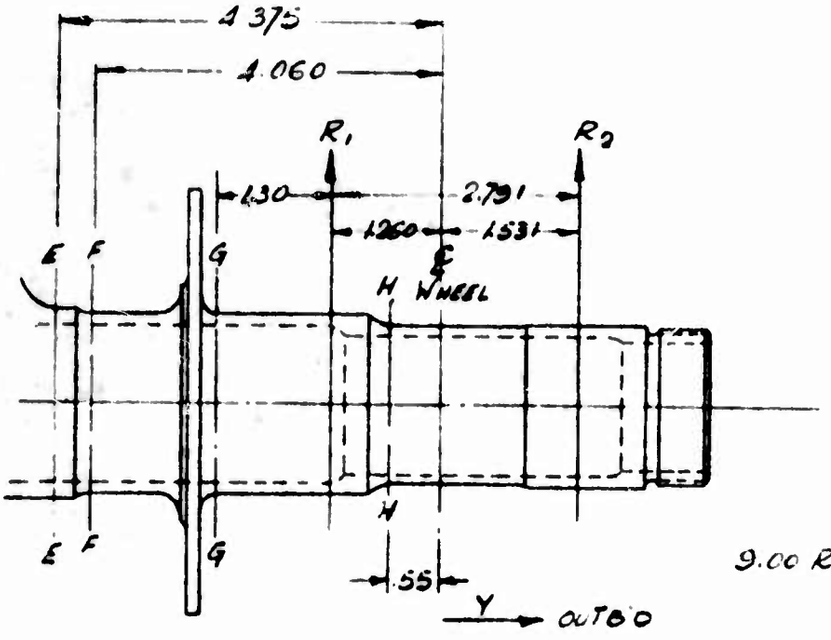
$f_{bu} = \frac{115000 \times 1.50 \times 1.370}{.9691} = 230926$ psi $\qquad R_{bu} = \frac{230926}{310000} = .745$

$f_c = \frac{11508 \times 1.50}{1.143} = 15102$ psi $\qquad R_c = \frac{15102}{242000} = .062$

$f_s = \frac{VQ}{Ib} = \frac{14580 \times .473}{.9691 \times .280} \times 1.50 = 38123$ psi $\qquad R_s = \frac{38123}{149000} = .256$

$MS_{ULT} = \frac{1}{.745 + .062} - 1 = +.24$ (COMP FIBER)

CALC			REVISED	DATE	MAIN GEAR PISTON	15106
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 77



SECTION E E (4.375 FROM ℄ WHEEL - INBD)

X = -9876 LBS
Y = 0
Z = 11670 LBS
} REF p. 36

CONDITION 2 PT TAIL DOWN SPRING BACK

SHEAR : -9876 ←→ 11670 = 15290 LBS

M_x = 4.375 x -9876 = -43208 IN LBS

M_z = 4.375 x 11670 = 51056 IN LBS

M = -43208 ←→ 51056 = 66890 IN LBS

OD = 2.100	3.464	.9547
ID = 1.760	2.433	.4710
2t = .340	A = 1.031 IN²	I = .4837 IN⁴
t = .170		

D/t = 2.100/.170 = 12.35

$Q = \frac{2.100^3 - 1.760^3}{12} \cdot .317$

CALC	[illegible]		REVISED	DATE	MAIN GEAR PISTON-AXLE	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 78
APR						

SECTION E-E CONT

$F_{bu} = 341000$ psi

$F_{su} = 149000$ psi

$f_{bu} = \frac{66890 \times 1.05 \times 1.50}{4837} = 217800$ psi $R_{bu} = \frac{217800}{341000} = .639$

$f_{su} = \frac{VQ}{Ib} = \frac{15290 \times .317 \times 1.50}{.4837 \times .340} = 44208$ psi $R_{su} = \frac{44208}{149000} = .297$

$MS_b = \frac{1}{.639} - 1 = \underline{+.56}$

$MS_s = \frac{1}{.297} - 1 = \underline{+ \text{LARGE}}$

CALC	46		REVISED	DATE	MAIN GEAR	15104
CHECK					PISTON - AXLE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 79
APR						

SECTION F-F (4.060 FROM ℄ WHEEL - INBD)

X = -9876 LBS
Y = 0
Z = 11670 LBS
REF p. 36

CONDITION 2 PT TAIL DOWN SPRING BACK

SHEAR = -9876 +← 11670 = 15290 LBS

M_X = 4.060 × -9876 = -40097 IN LBS

M_Z = 4.060 × 11670 = 47380 IN. LBS

M = -40097 +→ 47380 = 62070 IN. LBS

OD = 1.99 | 3.110 | .7698
ID = 1.76 | 2.433 | .4710
2t = .23 | A = .677 IN² | I = .2988 IN⁴
t = .115

D/t = 1.99/.115 = 17.30

$Q = \frac{1.99^3 - 1.76^3}{12} = .202$

F_{bu} = 321500 psi

F_{su} = 149000 psi

$f_{bu} = \frac{62070 \times .995 \times 1.50}{.2988} = 310038$ psi $R_{bu} = \frac{310038}{321500} = .964$

$f_{su} = \frac{VQ}{Ib} = \frac{15290 \times .202 \times 1.50}{.2988 \times .23} = 67413$ psi $R_{su} = \frac{67413}{149000} = .452$

$MS_b = \frac{1}{.964} - 1 = \underline{+.037}$

$MS_s = \frac{1}{.452} - 1 = \underline{+\text{LARGE}}$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					PISTON - AXLE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 80
APR						

SECTION G-G (2.56 FROM ℄ WHEEL - INBD)

CONDITION 2 PT TAIL DOWN SPRING BACK

X = -9876 LBS
Y = 0
Z = 11670 LBS
} REF p. 36

SHEAR = -9876 ←→ 11670 = 15290 LBS

M_x = 2.56 × -9876 = -25283 IN LBS

M_z = 2.56 × 11670 = 29875 IN LBS

M = -25283 ←→ 29875 = 39140 IN LBS

O D = 1.999
I D = 1.760
2t = .239
t = .1195

3.138
2.433
A = .705 IN^2

.7840
.4710
I = .3130 IN^4

$D/t = 1.999/.1195 = 16.73$

$Q = \frac{1.999^3 - 1.760^3}{12} = .211$

F_{bu} = 324000 psi

F_{su} = 149000 psi

$f_{bu} = \frac{39140 \times .9995 \times 1.50}{.3130} = 187478$ psi $R_{bu} = \frac{187478}{324000} = .579$

$f_{su} = \frac{VQ}{Ib} = \frac{15290 \times .211 \times 1.50}{.3130 \times .239} = 64690$ psi $R_{su} = \frac{64690}{149000} = .434$

$MS_b = \frac{1}{.579} - 1 = +.73$

$MS_s = \frac{1}{.434} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR PISTON - AXLE	15101
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 81
APR						

$$R_2 = -\frac{1.260}{2.791} Z - \frac{9.00}{2.791} Y \longleftrightarrow \frac{1.260}{2.791} X$$

$$R_2 = (-.451Z - 3.225Y) \longleftrightarrow .451X$$

$$R_1 = -\frac{1.531}{2.791} Z + \frac{9.00}{2.791} Y \longleftrightarrow \frac{1.531}{2.791} X$$

$$R_1 = (-.549Z + 3.225Y) \longleftrightarrow 549X$$

CONDITION 2 PT TAIL DOWN SPRING BACK - GEAR FWD CRITICAL

$R_2 = -.451 \times 11670 \longleftrightarrow 451X - 9876 = -6895$ LBS

$R_1 = -.549 \times 11670 \longleftrightarrow 549X - 9876 = -8394$ LBS

CALC	WB		REVISED	DATE	MAIN GEAR PISTON - AXLE	151CL
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 82

SECTION H-H (.55 FROM ℄ WHEEL - INBD)

CONDITION: 2 PT TAIL DOWN SPRING BACK

$M = 6895 \times 2.081 = 14348$ IN LBS

SHEAR = 6895 LBS

O D = 1.790	2.516	.5039
I D = 1.570	1.936	.2982
2t = .220	$A = .580\ IN^2$	$I = .2057\ IN^4$
t = .110		

$D/t = 1.790/.110 = 16.27$ $\qquad Q = \frac{1.790^3 - 1.570^3}{12} = .155$

$F_{bu} = 325000$ psi

$F_{su} = 149000$ psi

$f_{bu} = \frac{14348 \times .895 \times 1.50}{.2057} = 93642$ psi $\qquad R_{bu} = \frac{93642}{325000} = .288$

$f_{su} = \frac{VQ}{Ib} = \frac{6895 \times .155 \times 1.50}{.2057 \times .220} = 35424$ psi $\qquad R_{su} = \frac{35424}{149000} = .238$

$$MS_b = \frac{1}{.288} - 1 = \text{+ LARGE}$$

$$MS_s = \frac{1}{.238} - 1 = \text{+ LARGE}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR PISTON - AXLE	1510L
CHECK						RYAN.
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 83
APR						

CHECK of THREADED PORTION of AXLE

TENSION @ RELIEF GROOVE

MAX SIDE LOAD (Y) = 4858 LBS - COND 2 PT DRIFT-INBD WHEEL GEAR FWD.

THREAD = 1.750 - 16 UNEF 3A

RELIEF GROOVE = 1.650 MIN. DIA

AXLE BORE = 1.470 MAX. DIA.

AREA = 2.138 - 1.697 = .441 IN.²

$$f_{tu} = \frac{4858\,(1.5)}{.441} = 16524 \text{ psi}$$

$F_{tu} = 260000$ psi

$$MS_{ULT} = \frac{260000}{16524} - 1 = + \underline{\text{LARGE.}}$$

SHEAR ACROSS THREADS

PITCH DIA of THREAD = 1.7054 MIN. .565 MIN. LENGTH of THREAD

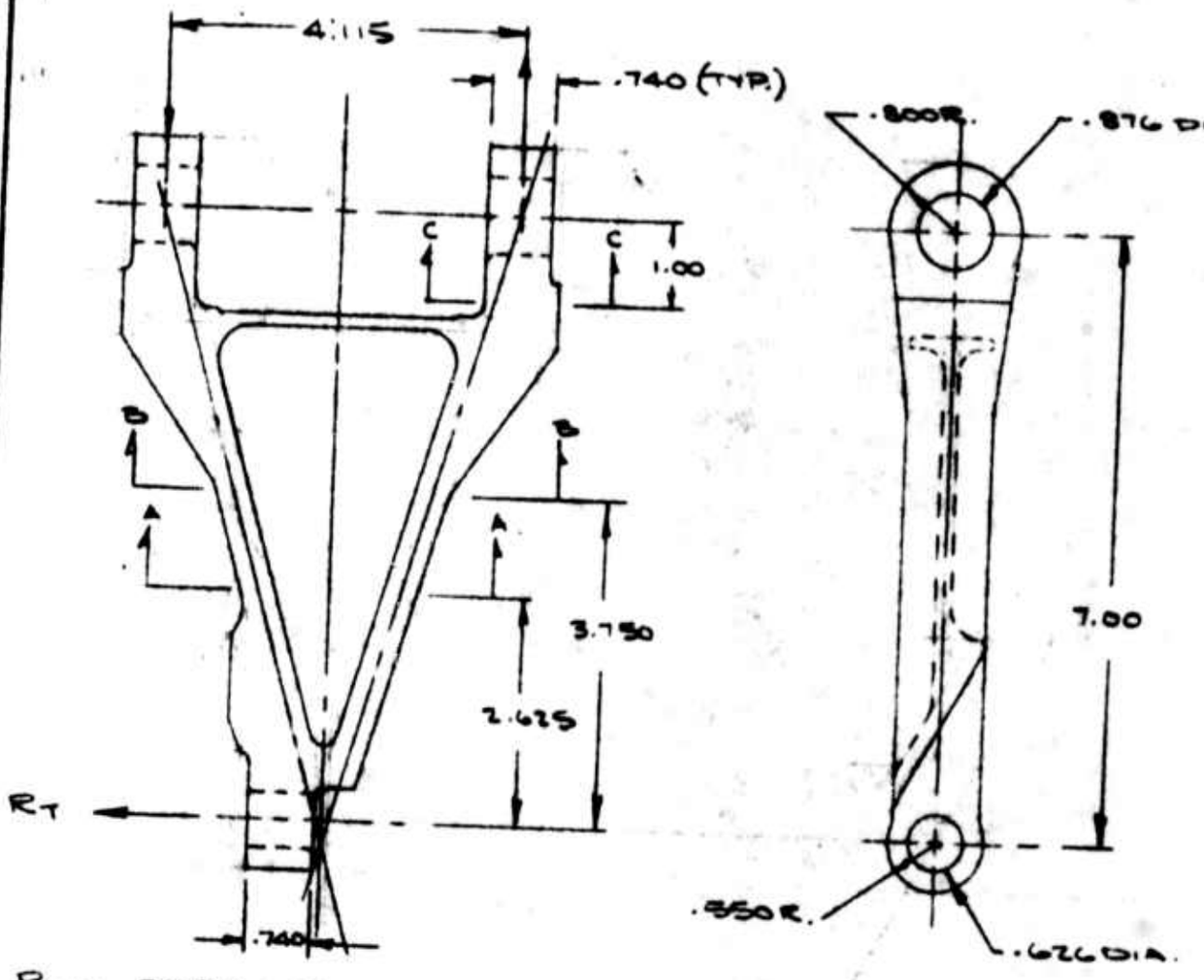
$$f_{su} = \frac{4858\,(1.5)}{1.7054 \times .565/2 \times \pi} = 4814 \text{ psi}$$

$F_{su} = 149000$ psi

$$MS_{ULT} = \frac{149000}{4814} - 1 = + \underline{\text{LARGE}}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR	1510L
CHECK					PISTON - AXLE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 84
APR						

UPPER TORQUE ARM 1510L125
CONDITION G CRITICAL



R_T = 8788 LB. REF p. 41

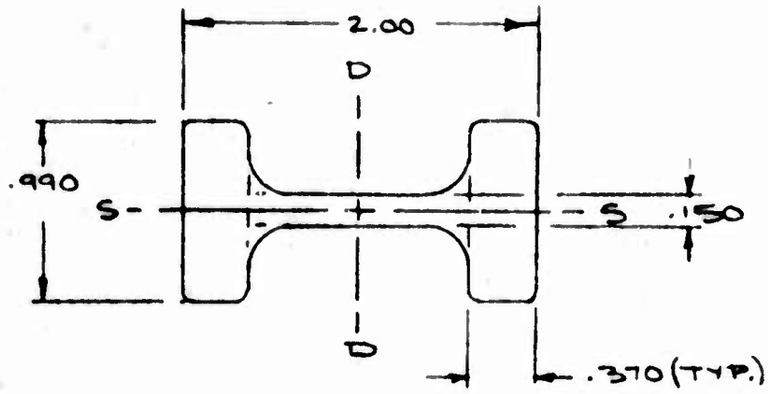
$P_{LUG} = \frac{8788 \times 7.00}{4.115} = 14950$ LB.

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER TORQUE ARM	RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 85
APR						

UPPER TORQUE ARM — 2014 T6 AWM. AL. HAND FORGING

CONDITION 6 CRITICAL

SECTION A-A — 2.625 IN. FROM 'T'



NEGLECTING FILLETS (CONSERVATIVE)

$$A = 2 \times .370 \times .99 + .150 \times 1.260 = .921 \text{ IN.}^2$$

$$I_{D\text{-}D} = \frac{.990 \times 2.00^3 - .840 \times 1.260^3}{12} = .520 \text{ IN.}^4$$

$$Q_{D\text{-}D} = .370 \times .99 \times .815 + .150 \times .630 \times .315$$

$$= .328$$

$$K_{D\text{-}D} = \frac{2 \times .328 \times 1.00}{.520} = 1.26$$

$$F_{bu_{D\text{-}D}} = 79000 \text{ PSI}$$

$$M_{A\text{-}A} = 8788 \times 2.625 = 23070 \text{ IN.-LB.}$$

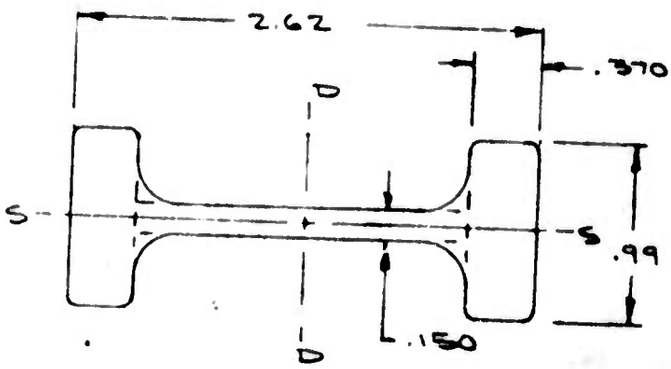
$$f_{bu} = \frac{23070 \times 1.5 \times 1.00}{.520} = 66550 \text{ PSI}$$

$$M.S. = \frac{79000}{66550} - 1 = \underline{.19}$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER TORQUE ARM	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 86

UPPER TORQUE ARM

SECTION B-B



NEGLECTING FILLETS (CONSERVATIVE)

$A = 2 \times .99 \times .370 + .150 \times 1.88 = 1.014 \text{ IN.}^2$

$I_{D-D} = \dfrac{.99 \times 2.62^3 - .84 \times 1.88^3}{12} = 1.018 \text{ IN.}^4$

$Q_{D-D} = .99 \times .370 \times 1.125 + .150 \times .94 \times .47 = .478$

$K_{D-D} = \dfrac{2 \times .478 \times 1.31}{1.018} = 1.23$

$F_{bu\,D-D} = 77300 \text{ PSI}$

$M_{B-B} = 8788 \times 3.75 = 32960 \text{ IN.-LB.}$

$f_{bu} = \dfrac{32960 \times 1.5 \times 1.31}{1.018} = 63650 \text{ PSI}$

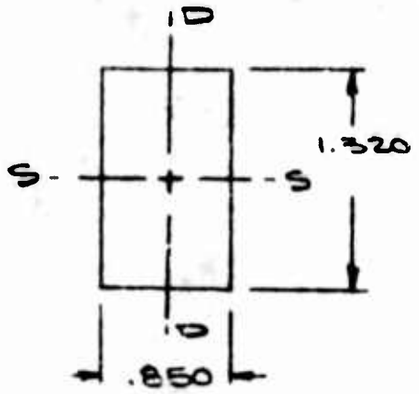
$$M.S. = \frac{77300}{63650} - 1 = \underline{.21}$$

CALC	Fredrick		REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER TORQUE ARM	RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 87
APR						

UPPER TORQUE ARM

SECTION C-C

SINCE END BOLT (1510L127) IS TORQUED 25 TO 55 LB.-IN. BOTH LUGS TAKE SOME OF THE LOAD IN BENDING. ASSUME A 60-40 LOADING CONDITION.



$A = .850 \times 1.320 = 1.122 \text{ IN.}^2$

$I_{D-D} = \frac{1.320 \times .850^3}{12} = .067 \text{ IN.}^4$

$Q_{D-D} = .425 \times 1.320 \times .213 = .119$

$K_{D-D} = \frac{2 \times .119 \times .425}{.067} = 1.5$

$F_{bu_{D-D}} = 92000 \text{ PSI}$

$M_{C-C} = .60 \times 8788 \times 1.00 = 5270 \text{ IN.-LBS.}$

$f_{bu} = \frac{5270 \times 1.5 \times .425}{.067} = 50140 \text{ PSI}$

$R_{bu} = \frac{50140}{92000} = .545$

$f_{tu} = \frac{14950 \times 1.5}{1.122} = 19990 \text{ PSI}$

$R_{tu} = \frac{19990}{65000} = .308$

$M.S. = \frac{1}{.545 + .308} - 1 = \underline{.17}$

SINCE LOWER TORQUE ARM IS SIMILAR AND SEES SAME APEX LOAD NO CALCULATION IS NECESSARY.

CALC	[illegible]		REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER TORQUE ARM	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 88

UPPER TORQUE ARM

CYLINDER ATTACHMENT LUG

P_{LUG} = 14950 LBS. REF p 85

a = .800
D = .876
W = 1.600
t = .740
W/D = 1.83
a/D = .91

$A_{br} = Dt = .648 \text{ IN.}^2$

$A_t = (W-D)t = .536 \text{ IN.}^2$

$K_t = .97$

$K_{br} = .70$

TENSION

$P'_{tu} = K_t F_{tu} A_t = .97 \times 65000 \times .536 = 33800 \text{ LB.}$

$$M.S. = \frac{33800}{1.15 \times 14950 \times 1.5} - 1 = \underline{.31}$$

SHEAR BEARING

$P_{bru} = K_{br} F_{tux} A_{br} = .70 \times 59000 \times .648 = 26760 \text{ LB.}$

$$M.S. = \frac{26760}{1.15 \times 14950 \times 1.5} - 1 = \underline{.04}$$

LUG YIELD

$$\frac{P'_u \text{ (MIN.)}}{A_{br} F_{tu}} = \frac{26760}{.648 \times 65000} = .635 \quad \therefore C = 1.1$$

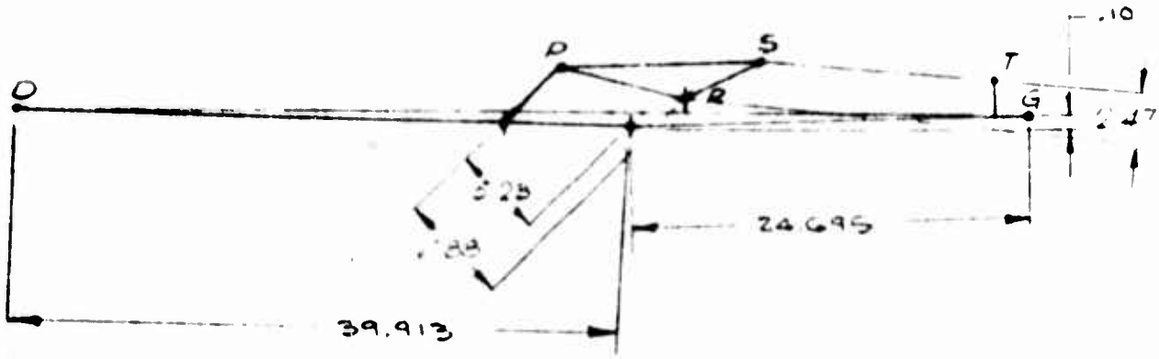
$$P'_y = C\left(\frac{F_{ty}}{F_{tu}}\right) P'_u \text{ (MIN.)} = 1.1 \left(\frac{55}{65}\right) 26760 = 24900 \text{ LB.}$$

$$\text{YIELD M.S.} = \frac{1.5 \times 24900}{1.15 \times 14950} - 1 = \underline{1.17}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER TORQUE ARM	RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 89
APR						

DRAG BRACE LOADING

C/N 5[illegible]



CONDITION 1

F_c = [illegible]

CONDITION 6

F_c = [illegible]

CALC	[illegible]		REVISED	DATE	MAIN GEAR DRAG BRACE	15 CL
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 90

COLUMN ANALYSIS

THE AVERAGE MOMENT OF INERTIA FOR THE DRAG BRACE WILL BE .8042 IN.^{4} FROM PAGE 93C.
THE COLUMN STABILITY WILL BE DETERMINED BY METHODS OF VIRTUAL WORK.

STABILITY ANALYSIS

1. ASSUME A UNIT AXIAL LOAD & A PARABOLIC DEFLECTION CURVE WITH A UNIT ECCENTRICITY. DETERMINE THE BENDING MOMENTS (M)
2. ASSUME A UNIT COMPRESSIVE LOAD AT POINT H IN DIRECTION ⊥ TO BRACE ℄ & DETERMINE BENDING MOMENTS (M')
3. DETERMINE CRITICAL (BUCKLING) LOAD FROM

$$P_{CR} = \frac{1}{\int \frac{M' M'' ds}{EI}}$$

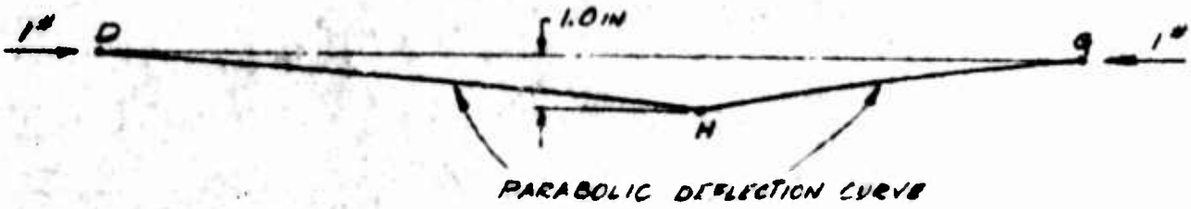
4. USING ACTUAL COMPRESSIVE FORCE, (P_c = 12,767 LBS) & ASSUMED INITIAL ECCENTRICITY OF .10 INS DETERMINE FINAL ECCENTRICITY FROM

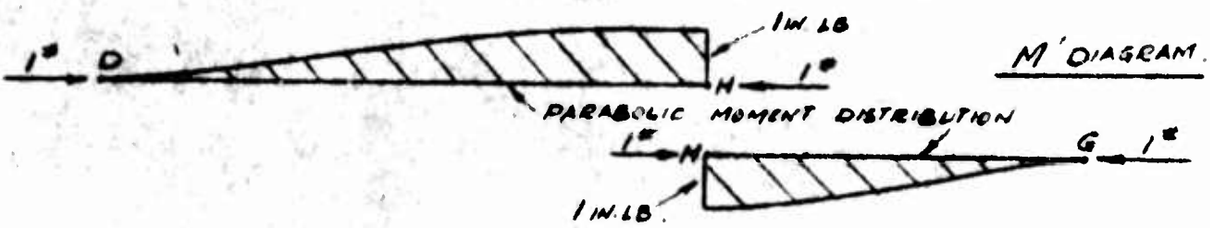
$$\delta = \delta_0 / 1 - P_c / P_{CR}$$

CALC			REVISED	DATE	MAIN GEAR DRAG BRACE	15104
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 91
APR						

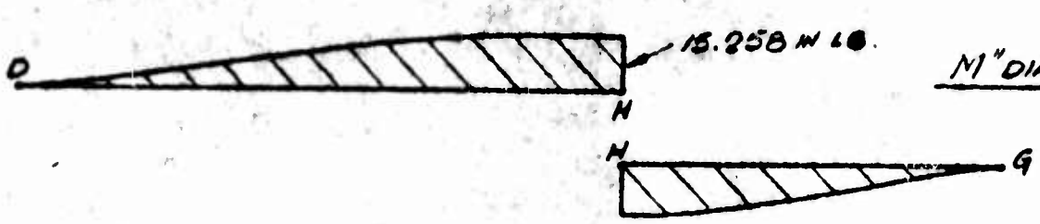
STABILITY ANALYSIS - CONT

1/ ASSUME P = 1.0 LB δ = 1.0 INS





2/ ASSUME DUMMY LOAD OF 1 LB @ 'H'



CALC			REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 92
APR						

STABILITY ANALYSIS - CONT

3/ DETERMINE CRITICAL BUCKLING LOAD P_{CR}

$\bar{OH}$ $\quad E/2\,(39.913)\left[\frac{(15.258)(1)}{.8042}\right] = 315.525$

$\bar{HG}$ $\quad E/2\,(24.695)\left[\frac{(15.258)(1)}{.8042}\right] = 195.223$

510.748

$$P_{CR} = \frac{10.3\times10^6}{510.748} = 20160 \text{ LB.}$$

4/ DETERMINE FINAL ECCENTRICITY

$$\delta = \frac{.10}{1 - \frac{12767}{20160}} = .2727$$

BM 1 TO DIN @ POINT H $= .2727 \times 12767 = 3482$ IN LBS

GENERAL COLUMN STABILITY

$P_c = 12767$ LBS

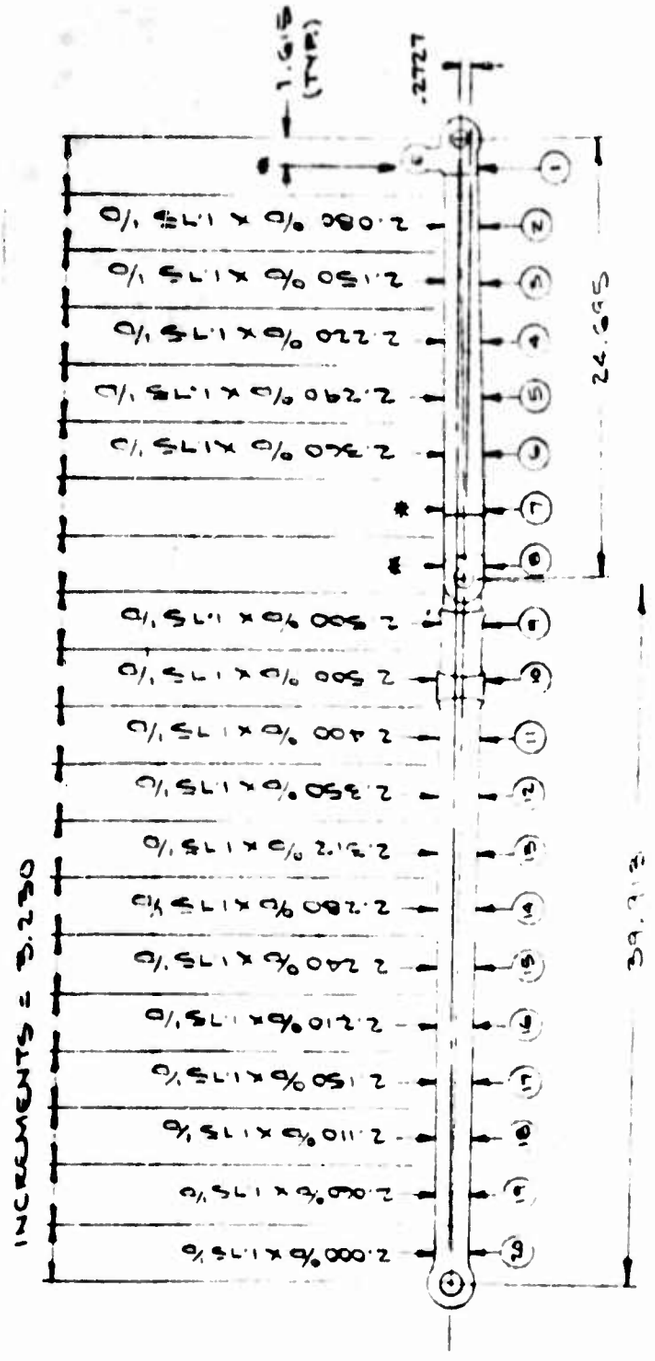
$P_{CR} = 20160$ LBS

$P_c/P_{CR} = 12767/20160 = .633$

SINCE $P_c/P_{CR} < 1.0$ COLUMN IS STABLE

CALC			REVISED	DATE	MAIN GEAR DRAG BRACE	15101
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 93
APR						

COLUMN STABILITY ANALYSIS CONT.



* ① WILL USE AVERAGE I OF ROUND & RECTANGLE TO EITHER SIDE OF SECTION

* ⑦ WILL USE AVERAGE I OF 2.390"D x 1.75"D AND I OF SECTION.

* ⑧ WILL USE I OF RECTANGULAR SECTION.

NOTE:
COLUMN STABILITY BY (REF. 05.4 DOUGLAS AIRCRAFT STRESS MANUAL) CONSIDERING .273 IN. FINAL ECCENTRICITY PER PAGE 93.

CALC	C. Smith		REVISED	DATE
CHECK				
APR				
APR				

MAIN GEAR

DRAG BRACE

H W LOUD MACHINE WORKS INC
8817 EAST SECOND ST. POMONA CALIFORNIA

1510L

RYAN

PAGE 93A

COLUMN STABILITY CONT.

No.	AREA	K	I MIDPOINT	E	EI $\times 10^6$	$\frac{K}{EI} \times 10^{-6}$
1	.7515	.020	.1920	10.3×10^6	1.9776	.0101
2	.9926	.177	.4584		4.7215	.0375
3	1.2255	.476	.5885		6.0616	.0785
4	1.4658	.887	.7319		7.5386	.1177
5	1.7137	1.370	.8895		9.1619	.1495
6	1.9694	1.879	1.0623		10.9417	.1717
7	1.9480	2.362	1.0135		10.4391	.2263
8	1.8150	2.773	.8858		9.1237	.3039
9	2.5038	3.072	1.4571		15.0081	.2047
10	2.5038	3.229	1.4571		15.0081	.2152
11	2.1189	3.229	1.1682		12.0325	.2684
12	1.9324	3.072	1.0367		10.6780	.2877
13	1.7932	2.773	.9416		9.6985	.2859
14	1.6778	2.362	.8661		8.9208	.2648
15	1.5358	1.879	.7754		7.9866	.2353
16	1.4309	1.370	.7105		7.3182	.1872
17	1.2255	.887	.5885		6.0616	.1463
18	1.0917	.476	.5125		5.2788	.0902
19	.9279	.177	.4236		4.3631	.0406
20	.7366	.020	.3250	10.3×10^6	3.3475	.0060
	$\Sigma = 31.3598$		$\Sigma = 16.0842$			$\Sigma = 3.3275$

CALC	Penthal		REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 93B
APR						

COLUMN STABILITY CONT.

$$\Sigma_o^L \frac{K}{EI} = \frac{3.3275}{10^6}$$

$$P_{CR} = \frac{320\,(.9)}{(L^2)\,\Sigma_o^L \frac{K}{EI}}$$

$$P_{CR} = \frac{320 \times .9 \times 10^6}{(64.608)^2 \times 3.3275} = 20735 \text{ LBS.}$$

AREA (AVG) = 1.5680 IN.^{2} $\qquad$ I(AVG) = .8042 IN.^{4}

$$.7854\,(O.D.^2 - 1.75^2) = 1.5680$$

$$O.D.^2 = 1.9964 + 3.0625 = 5.0589$$

O.D. = 2.250 IN. (AVG)

C (AVG) = 1.125 IN. $\qquad$ t = 2.250 - 1.75/2 = .250 (AVG)

$$D/t\ (AVG) = \frac{2.250}{.250} = 9.0$$

$$F_{bu} = \left(\frac{80}{74}\right) 99800 = 107880 \text{ PSI}$$

$$f_b = \frac{.2727 \times 12767 \times 1.125 \times 1.5}{.8042} = 7306 \text{ PSI}$$ (1)

$$R_b = \frac{7306}{107880} = .068$$

$$R_{CR} = \frac{12767 \times 1.5}{20735} = .924$$

$$M.S. = \frac{1}{.924 + .068} - 1 = .01$$

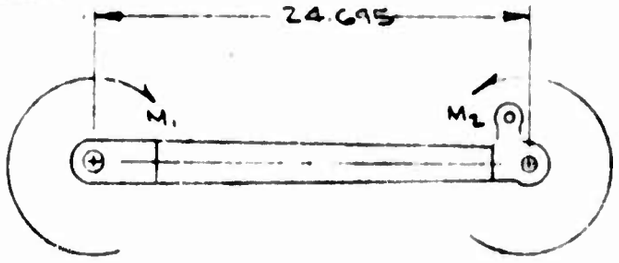
(1) CONSERVATIVELY USE FINAL ECCENTRICITY REF. P. 93.

CALC	[illegible]		REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 93 C
APR						

COLUMN ANALYSIS CONT.

CONSIDERING UPPER DRAG BRACE AS A BEAM COLUMN WITH AXIAL LOAD AND END MOMENTS.

$P_c = 12767$ LBS.



$A_{(AVG)} = 1.485$ IN.^{2}

$I_{(AVG)} = .7277$ IN.^{4}

$M_1 = .2727 \times 12767 = 3482$ IN-LB

$M_2 = 0$

$$M_{MAX} = \frac{M_1}{\cos \frac{x}{J}}$$

$$J = \sqrt{EI/P_c} = \sqrt{\frac{10.3 \times 10^6 \times .7277}{12767}} = \sqrt{5.8708 \times 10^2} = 24.230$$

$$L/J = 24.695/24.230 = 1.019$$

$$\tan \frac{x}{J} = \frac{M_1 \cos \frac{L}{J}}{M_1 \sin \frac{L}{J}} = \frac{3482\ (.52337)}{3482\ (.85211)} = .6142$$

$$\cos \frac{x}{J} = .8521$$

$$M_{MAX} = \frac{3482}{.8521} = 4086 \text{ IN-LBS.}$$

CALC	[signature]		REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 93 D
APR						

COLUMN ANALYSIS CONT.

CONSIDERING LOWER DRAG BRACE AS A BEAM COLUMN WITH AXIAL LOAD & END MOMENTS.

$P_c = 12767$ LB.

$A_{(AVG)} = 1.623$ IN.^{2}

$I_{(AVG)} = .8552$ IN.^{4}

$M_1 = .2727 \times 12767 = 3482$ IN-LB

$M_2 = 0$

$$M_{MAX} = \frac{M_1}{\cos \frac{x}{J}}$$

$$J = \sqrt{EI/P_c} = \sqrt{\frac{10.3 \times 10^6 \times .8552}{12767}} = \sqrt{6.8994 \times 10^2} = 26.267$$

$L/J = 39.913/26.267 = 1.520$

$$\tan \frac{x}{J} = \frac{M_1 \cos \frac{L}{J}}{M_1 \sin \frac{L}{J}} = \frac{3482\ (.05017)}{3482\ (.99871)} = .05083$$

$\cos \frac{x}{J} = .99871$

$$M_{MAX} = \frac{3482}{.99871} = 3486 \text{ IN-LB}$$

CALC	Barchet		REVISED	DATE	MAIN GEAR	1510L
CHECK					DRAG BRACE	RYAN
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 93 E

COLUMN ANALYSIS CONT.
(LOWER DRAG BRACE)

$$\rho = \sqrt{I/A} = \sqrt{.8552/1.623} = (.5269)^{1/2} = .726$$

$$L' = \frac{L}{\sqrt{C}} = L$$

$$L'/\rho = \frac{39.913}{.726} = 54.977$$

$F_{co} = 1.075\, F_{cy} = 1.075 \times 72000 = 77400$ PSI

TRANSITIONAL $L'/\rho = 1.414\pi \sqrt{\frac{10.3\times10^6}{7.74\times10^4}} = 51.06$

LONG COLUMN

$$\therefore F_c = \pi^2 E/(L'/\rho)^2 = \frac{9.870 \times 10.3\times10^6}{(54.977)^2} = \frac{101.661 \times 10^4}{30.225}$$

$F_c = 33635$ PSI

$D_{(AVG)} = 2.250$ $\qquad t_{(AVG)} = .250$

$D/t = 9.0$ $\qquad F_{bu} = \left(\frac{80}{74}\right) 99800 = 107880$ PSI

$$f_c = \frac{12767 \times 1.5}{1.623} = 11800 \text{ PSI} \qquad R_c = \frac{11800}{33635} = .351$$

$$f_b = \frac{3486 \times 1.125 \times 1.5}{.8552} = 6870 \text{ PSI} \qquad R_b = \frac{6880}{107880} = .064$$

$$M.S. = \frac{1}{.351 + .064} - 1 = \underline{1.41}$$

CHKD			REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
STRESS						RYAN
APP						
APP					M. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 93 F

COLUMN STABILITY CONT.

(UPPER DRAG BRACE)

$$\rho = \sqrt{I/A} = \sqrt{\frac{.7277}{1.485}} = (.4900)^{1/2} = .700$$

$$L' = \frac{1}{\sqrt{C}} = L$$

$$L'/\rho = \frac{24.695}{.700} = 35.279$$

$$F_{co} = 1.075\, F_{cy} = 1.075 \times 72000 = 77400 \text{ PSI}$$

$$\text{TRANSITIONAL } L'/\rho = 1.414\pi \sqrt{\frac{10.3 \times 10^6}{7.74 \times 10^4}} = 51.06$$

SHORT COLUMN

$$F_c = F_{co}\left[1 - F_{co}(L'/\rho)^2/4\pi^2 E\right]$$

$$= 7.74 \times 10^4 \left[1 - (7.74 \times 10^4)(35.279)^2/4(9.870)(10.3 \times 10^6)\right]$$

$$= 7.74 \times 10^4 \left[1 - \frac{96333 \times 10^6}{406.644 \times 10^6}\right]$$

$$= 7.74 \times 10^4 \left(1 - .237\right) = 7.74 \times 10^4 \times .763 = 5.906 \times 10^4$$

$$= 59060 \text{ PSI}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST. POMONA CALIFORNIA	PAGE 93G
APR						

COLUMN ANALYSIS CONT.

(UPPER DRAG BRACE)

$.7854\left(O.D.^2 - 1.75^2\right) = 1.485$

$O.D.^2 = \frac{1.485}{.7854} + 1.75^2 = 1.8903 + 3.0625 = 4.9528$

O.D. (AVG) = 2.226

C(AVG) = 1.113

$t_{(AVG)} = 2.226 - 1.75/2 = .238$

$D/t = 2.226/.238 = 9.35$

$F_{bu} = \left(\frac{80}{74}\right) 99500 = 107560 \text{ PSI}$

$f_c = \frac{1276 \times 1.5}{1.485} = 1289 \text{ PSI}$

$R_c = \frac{1289}{59060} = .218$

$f_b = \frac{4086 \times 1.113 \times 1.5}{.7277} = 9374 \text{ PSI}$

$R_b = \frac{9374}{107560} = .087$

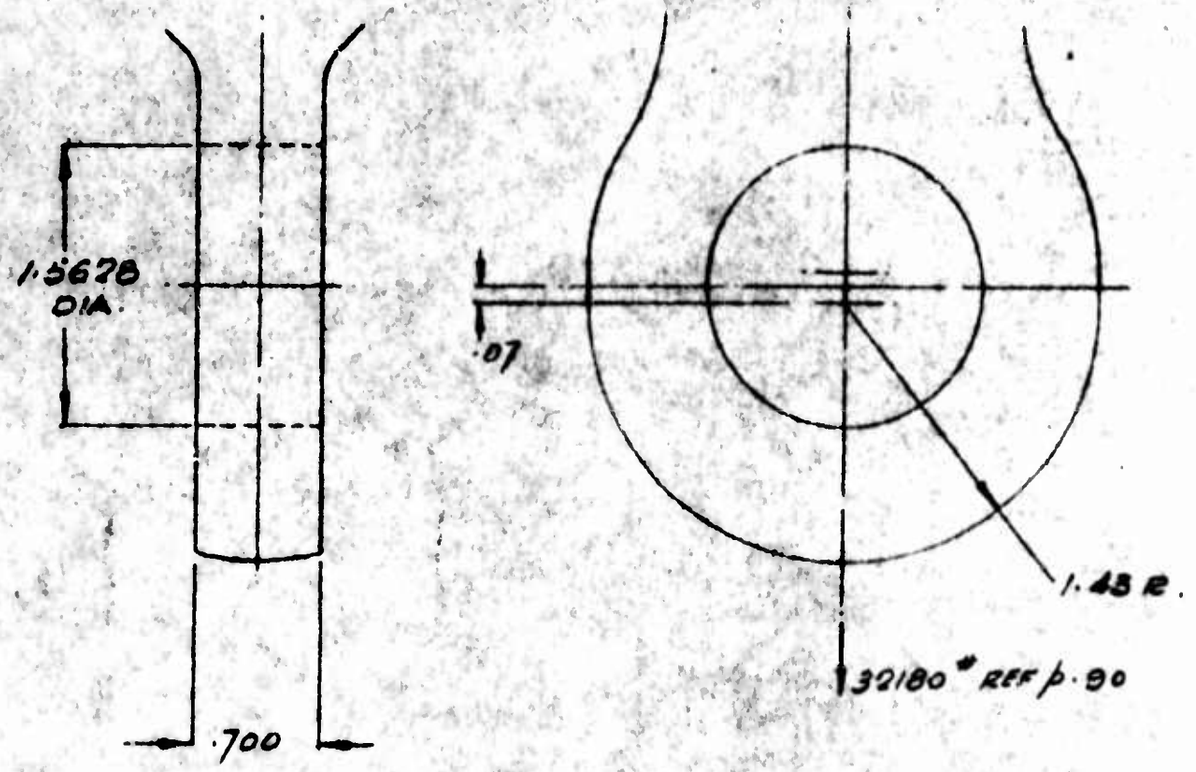
$M.S. = \frac{1}{.218 + .087} - 1 = +1.66$

CALC	Bahit		REVISED	DATE	MAIN GEAR	1510L
CHECK					DRAG BRACE	RYAN
APR						
APR					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 93 H

LOWER DRAG BRACE P/N 1510L211 MAT'L 7075-T6 ALUM ALLOY

ATTACH MT LUG @ O.

CONDITION 6 CRITICAL.



TENSION.

$P'_{tu} = K_t F_{tu} A_t$

W = 2.86

O = 1.5628

T = .700

$W/O = 2.86/1.5628 = 1.830$ $K_t = .975$

$A_t = (2.86 - 1.5628) \times .700 = .908$

$F_{tu} = 80000$ psi

$P'_{tu} = .975 \times 71000 \times .908 = 62856$ LBS

$MS_{ult} = \frac{62856}{32180 \times 1.50 \times 1.5} - 1 = +.18$

CALC			REVISED	DATE
CHECK				
APR				
APR				

MAIN GEAR

LOWER DRAG BRACE ASSY.

1510L

RYAN

H. W. LOUD MACHINE WORKS, INC.
887 EAST SECOND ST., POMONA, CALIFORNIA

PAGE 94

ATTACH MT LUG @ 'O' CONT

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

$a = 1.43 + .07 = 1.50$

$O = 1.5628$

$T = .700$

$a/O = 1.50/1.5628 = .960$ $\qquad K_{br} = .80$

$$A_{br} = 1.5628 \times .700 = 1.0940$$

$$P'_{bru} = .80 \times 80000 \times 1.094 = 70016 \text{ LBS}$$

$$MS_{ULT} = \frac{70016}{32180 \times 1.50 \times 1.15} - 1 = +.26$$

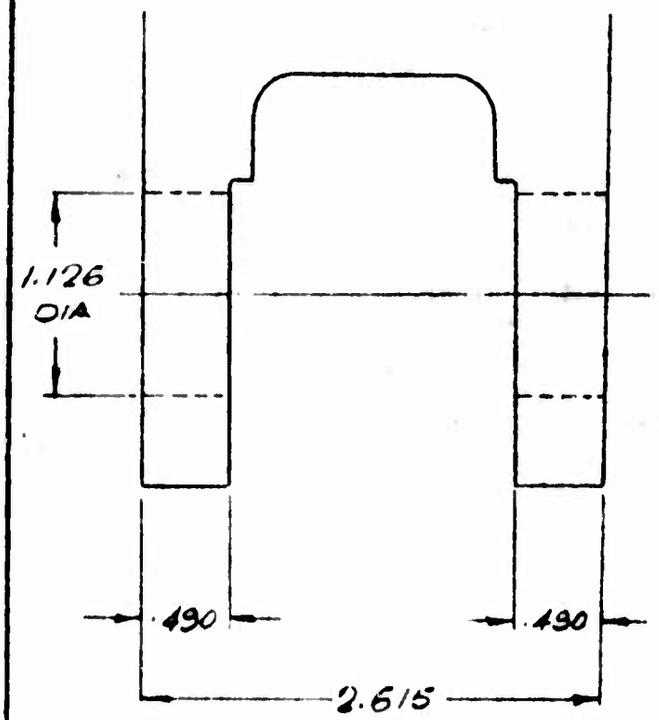
(1.15 = FITTING FACTOR)

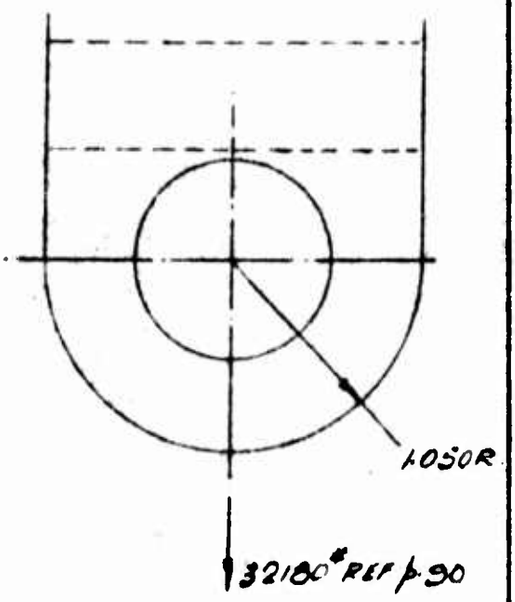
CALC			REVISED	DATE	MAIN GEAR	15106
CHECK					LOWER DRAG BRACE ASSY	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 857 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 95
APR						

LOWER DRAG BRACE

ATTACH^MT LUG @ 'H'

CONDITION 6 CRITICAL





TENSION

$$P'_{tu} = K_t F_{tu} A_t$$

W = 2.10

D = 1.126

T = .490 × 2 = .980

$W/D = 2.10/1.126 = 1.865$ $\quad K_t = .97$

$A_t = (2.10 - 1.126) \times .980 = .9545$

$F_{tu} = 80000$ psi.

$P'_{tu} = .97 \times 80000 \times .9545 = 74069$ LBS.

$$MS_{ult} = \frac{74069}{32180 \times 1.50 \times 1.15} - 1 = +.35$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					LOWER DRAG BRACE ASSY	RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 96
APR						

ATTACH^MT LUG @ H' CONT

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tu_y} A_{br}$$

$a = 1.05$

$D = 1.126$

$T = .980$

$a/D = 1.05/1.126 = .933$ $\quad K_{br} = .75$

$$A_{br} = 1.126 \times .980 = 1.103$$

$$P'_{bru} = .75 \times 80000 \times 1.103 = 66180.85$$

$$MS_{ULT} = \frac{66180}{32180 \times 1.50 \times 1.15} - 1 = \underline{+.19}$$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR	15104
CHECK					LOWER DRAG BRACE ASSY	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 97
APR						

LOWER DRAG BRACE

TENSION IN TUBE SECTION — CONDITION 6 CRITICAL

MIN O/D = 1.990
MAX I/D = 1.760

3.1163
2.4389
A = .6774 IN²

$F_{tu} = 80000$ psi

$$f_{tu} = \frac{32180 \times 1.50}{.6774} = 71258 \text{ psi}$$

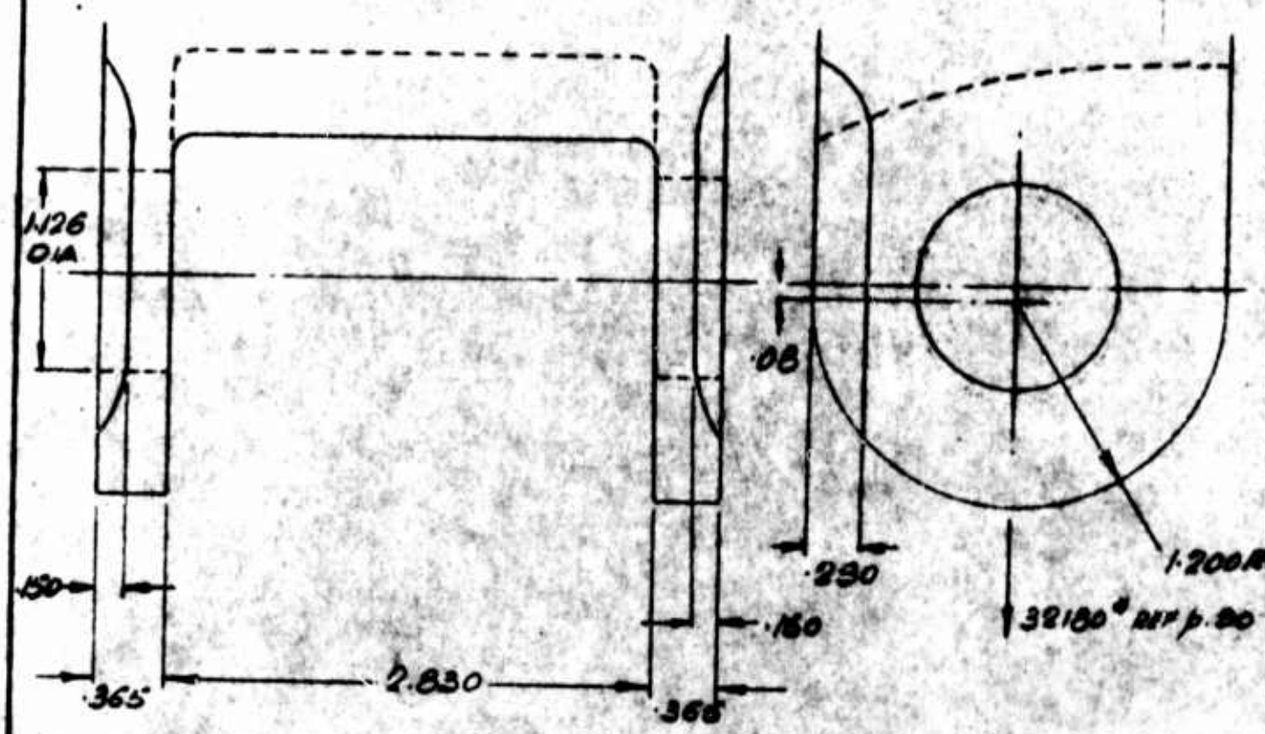
$$MS_{ULT} = \frac{80000}{71258} - 1 = +.12$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR LOWER DRAG BRACE ASSY	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 98
APR						

UPPER DRAG BRACE P/N 1510L212 MAT'L 7075-T6 ALUM. ALLOY

ATTACH MT LUG @ H

CONDITION 6 CRITICAL



TENSION.

W = 2.400

D = 1.126

T = .365

$W/D = 2.400/1.126 = 2.131 \quad K_t = .86$

$A_t = (2.400 - 1.126) \times .730 - (1.150 \times .290) = .8865$

$F_{tu} = 80000$ psi

$P'_{tu} = .96 \times 80000 \times .8865 = 68088$ LBS.

$$MS_{ult} = \frac{68088}{32180 \times 1.50 \times 1.15} - 1 = +.23$$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER DRAG BRACE ASSY	RYAN.
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 99

ATTACH MT LUG @ H - CONT.

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

a = 1.20 + .08 = 1.28

D = 1.126

T = .365

$a/D = 1.28/1.126 = 1.14$ $\quad K_{br} = .98$

$A_{br} = 1.126 \times .730 = .822$

$P'_{bru} = .98 \times 80000 \times .822 = 64,445$ LBS.

$$M/S_{ULT} = \frac{64445}{32180 \times 1.50 \times 1.15} - 1 = +.16$$

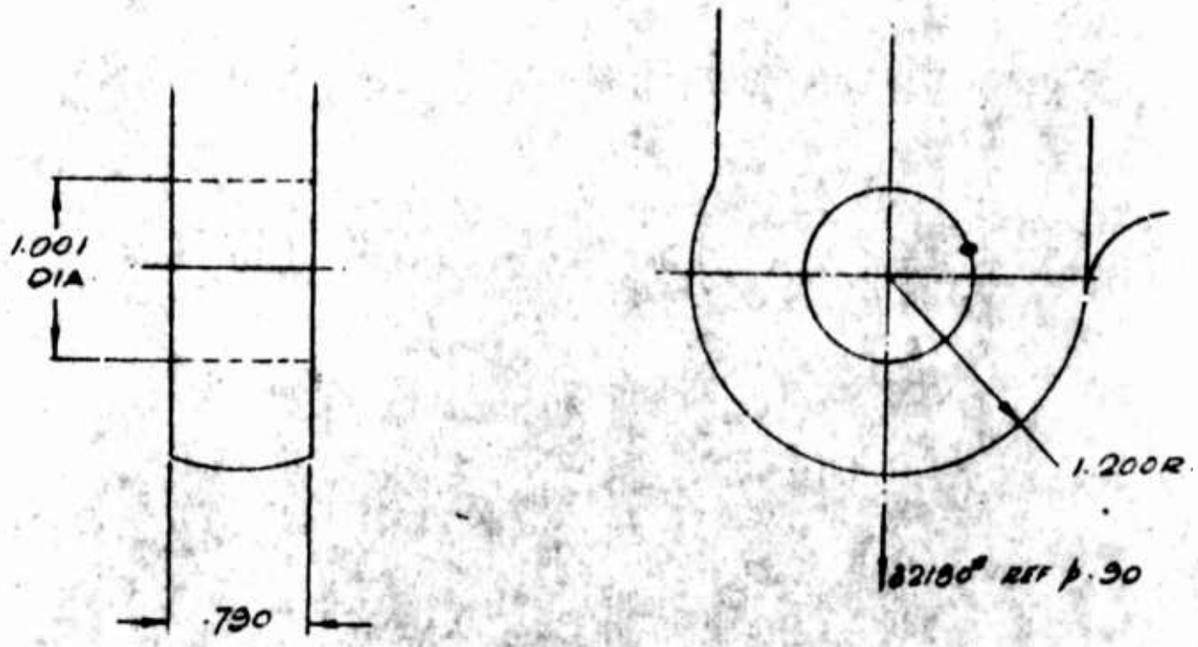
(1.15 = FITTING FACTOR)

CALC				REVISED	DATE	MAIN GEAR UPPER DRAG BRACE ASSY	1510L
CHECK							RYAN
APR						H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 100
APR							

UPPER DRAG BRACE

ATTACHMT LUG @ G

CONDITION 6 CRITICAL



TENSION

$$P'_{tu} = K_t F_{tu} A_t$$

W = 2.400

D = 1.001

T = .790

$W/D = 2.400/1.001 = 2.40 \qquad K_t = .940$

$A_t = (2.40 - 1.001) \times .790 = 1.105$

$F_{tu} = 80000$ psi

$P'_{tu} = .940 \times 80000 \times 1.105 = 83096$ LBS

$$MS_{ULT} = \frac{83096}{32180 \times 1.50 \times 1.15} - 1 = +.50$$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR	15101
CHECK					UPPER DRAG BRACE ASSY	RYAN
APR					H. W. LOUD MACHINE WORKS, INC.	PAGE
APR					857 EAST SECOND ST., POMONA, CALIFORNIA	101

ATTACH MT LUG @ G - CONT.

SHEAR - BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

$a = 1.20$

$D = 1.001$

$T = .790$

$a/D = 1.20/1.001 = 1.20 \qquad K_{br} = 1.02$

$$A_{br} = 1.001 \times .790 = .790$$

$$P'_{bru} = 1.02 \times 80000 \times .790 = 64464 \text{ LBS}$$

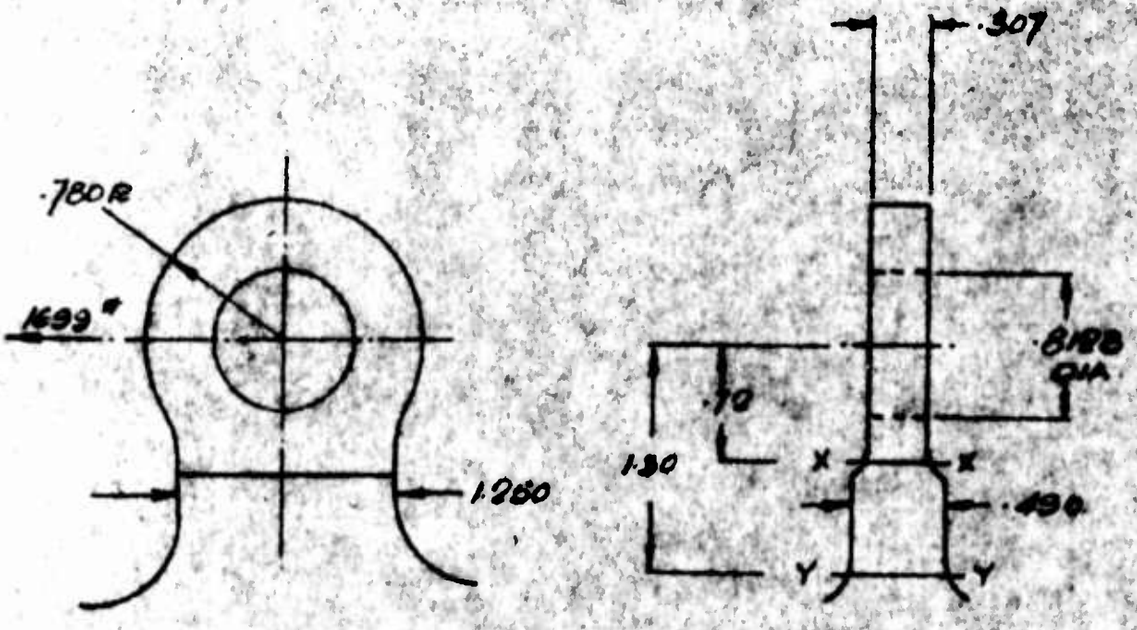
$$MS_{ULT} = \frac{64464}{32180 \times 1.50 \times 1.15} - 1 = \underline{+.16}$$

(1.15 = FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER DRAG BRACE ASSY	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 102
APR						

UPPER DRAG BRACE

ATTACH MT LUG @ T.



BM ⊥ TO PIN @ POINT H = 3192 IN LBS — REF p. 93

$P_{PIN} = 3192/6.73 = 610$ LBS (LIMIT)

$P_{ST} = 6.88/9.47 \times 610 = 1699$ LBS (LIMIT)

REFER TO DIAGRAM p. 90

SHEAR

ASSUME SHEAR AREA = (.780 - .4864) × .307 × 2 = .2294 IN.²

$F_{SU} = 44000$ PSI

$f_{SU} = \frac{1699 \times 1.50}{.2294} = 11109$ PSI

$MS_{ULT} = \frac{44000}{11109} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR	1501
CHECK					UPPER DRAG BRACE ASSY	RYAN
APR					H. W. LOUIS MACHINE WORKS, INC.	
APR					827 EAST GOSHEN ST., FRESNO, CALIFORNIA	PAGE 109

ATTACHMT LUG @ T - CONT

SECTION 'X-X'

$M = 1699 \times .72 = 1223$ IN. LBS.

AREA $= 1.250 \times .307 = .3838$ IN^2

$I = \frac{.307 \times 1.25^3}{12} = .050$ IN.^{4} $\quad K = 1.5$

$F_{bu} = 80/74 \times 105000 = 113516$ psi

$F_{su} = 44000$ psi

$f_{bu} = \frac{1223 \times 1.50 \times .625}{.050} = 22931$ psi $\quad R_{bu} = \frac{22931}{113516} = .202$

$f_{su} = \frac{1699 \times 1.50}{.3838} = 6640$ psi $\quad R_{su} = \frac{6640}{44000} = .151$

$MS_{ULT} = \frac{1}{.202 + .151 \times 1.15^{*}} - 1 = +\text{LARGE}$

* FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					UPPER DRAG BRACE ASSY.	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 104.
APR						

ATTACH'MT LUG @ T - CONT.

SECTION 'Y-Y'

$M = 1699 \times 1.30 = 2209$ IN LBS.

AREA $= 1.250 \times .490 = .6125$ IN^2

$I = \frac{.490 \times 1.25^3}{12} = .0798$ IN^4 $\quad K = 150$

$F_{bu} = 80/74 \times 105000 = 113516$ psi

$F_{su} = 44000$ psi

$f_{bu} = \frac{2209 \times 1.50 \times 1.15}{.0798} = 47751$ psi $\quad R_{bu} = \frac{47751}{113516} = .421$

$f_{su} = \frac{1699 \times 1.50}{.6125} = 4161$ psi $\quad R_{su} = \frac{4161}{44000} = .095$

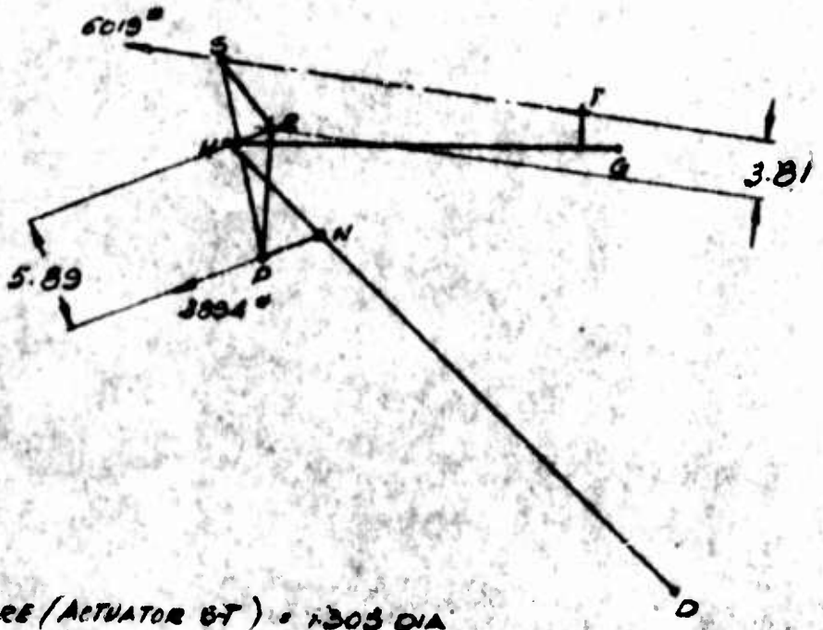
$$MS_{ULT} = \frac{1}{.421 + \frac{.095 \times 1.15}{A}} - 1 = +\text{LARGE}$$

A = FITTING FACTOR

CALC	[illegible]		REVISED	DATE	MAIN GEAR UPPER DRAG BRACE ASSY	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE .105
APR						

RETRACTION LINKAGE LOADING

(80° RETRACTED)



CYLINDER BORE (ACTUATOR ST) = 4.303 DIA

AREA = 14.537 IN.²

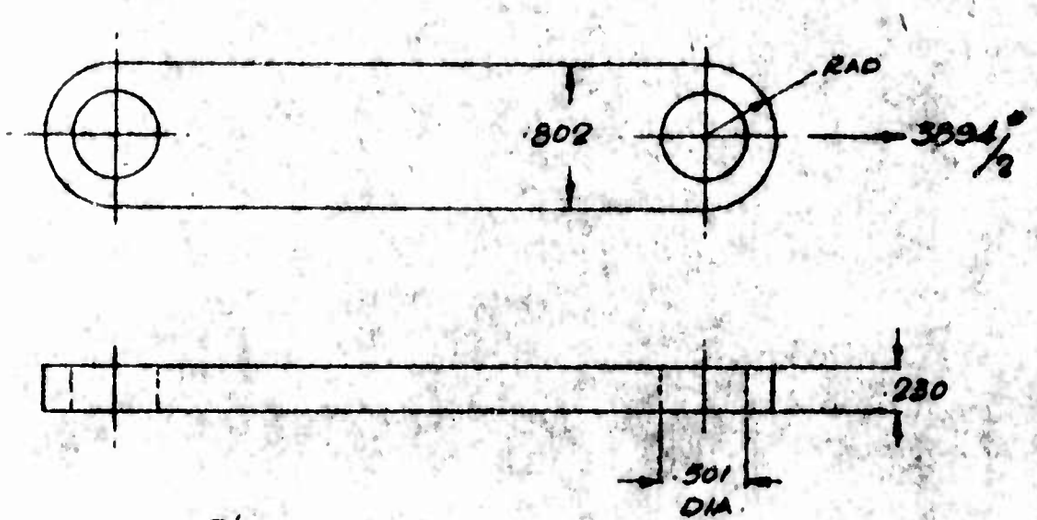
PROOF PRESSURE = 4500 psi

$P_{ST} = 14.537 \times 4500 = 6019$ LBS.

$P_{PN} = 3.81/5.89 \times 6019 = 3894$ LBS.

CALC			REVISED	DATE	MAIN GEAR DRAG BRACE	1510L
CHECK						
APR						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 106

LINK P/N 1510L 213 MAT'L ALUM ALLOY 7075-T6



TENSION $P'_{tu} = K_t F_{tu} A_t$

W: .802

D: .501

T: .230

$W/D = .802/.501 = 1.60$ $K_t = .98$

$A_t = (.802 - .501) \times .230 = .069$

$F_{tu} = 80000$ psi

$P'_{tu} = .98 \times 80000 \times .069 = 5413$ LBS.

$MS_{ULT} = \frac{5410}{1947 \times 1.15} - 1 = +$ LARGE

1.15 FITTING FACTOR

SHEAR-BEARING.

$P'_{bru} = K_{br} F_{tu} A_{br}$

a: .401

D: .501

T: .230

$a/D = .401/.501 = .800$

$K_{br} = .58$

$A_{br} = .501 \times .230 = .115$

$P'_{bru} = .58 \times 80000 \times .115 = 5336$ LBS.

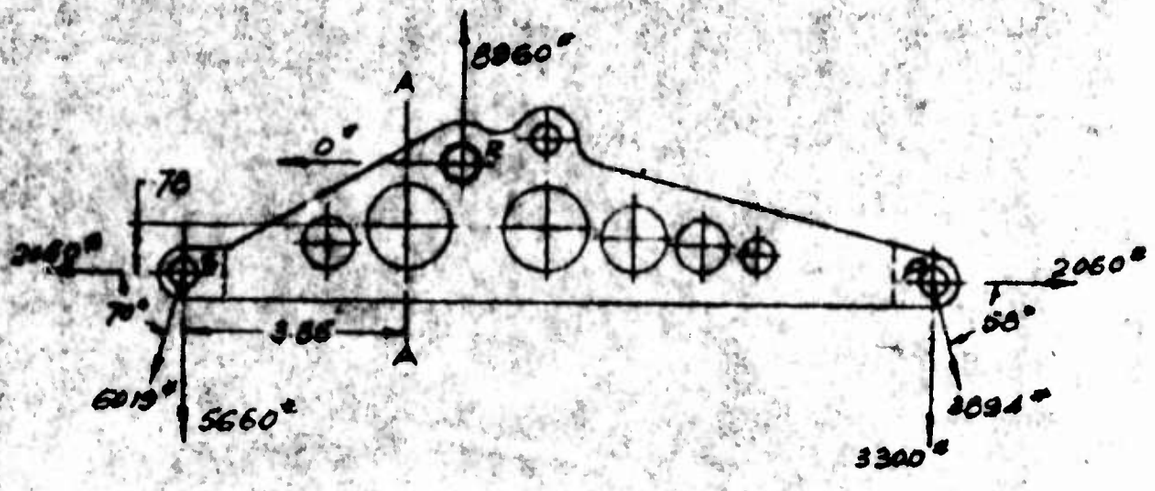
$MS_{ULT} = \frac{5336}{1947 \times 1.15} - 1 = +$ LARGE

1.15 FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR LINK - DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 807 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 107
APR						

TRIANGULAR FRAME P/N 15101-214 MAT'L ALUM ALLOY 7075-T6

(80° RETRACTED)



SIN 70° x 6019 = 5660 LBS

COS 70° x 6019 = 2060 LBS.

SIN 68° x 3894 = 3300 LBS.

COS 68° x 3894 = 2060 LBS.

VERT Σ R = 5660 + 3300 = 8960 LBS.

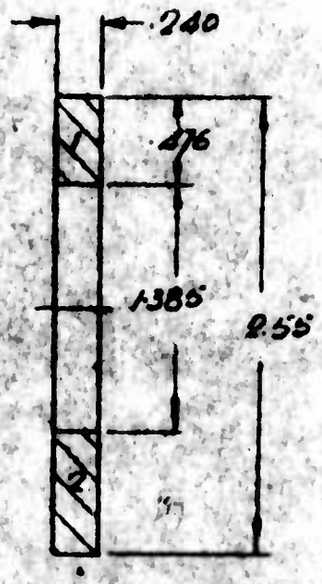
DRAG Σ R = 2060 - 2060 = 0 LBS.

CALC			REVISED	DATE	MAIN GEAR FRAME-DRAG BRACE	15101
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 108
APP						

TRIANGULAR FRAME - CONT

SECTION A-A

	A	V	AV	AV^2	I_{oo}
1	.1142	.9305	.1063	.0989	.0022
2	.1654	-1.037	-.1715	.1779	.0065
Σ	.1796		-.0652	.2768	.0087



$$\bar{V} = \frac{\Sigma AV}{\Sigma A} = \frac{-.0652}{.1796} = -.363$$

$$I_{oo} = I_{o_o} + \Sigma AV^2 - \bar{V}(\Sigma AV)$$

$$= .0087 + .2768 - (-.363 \times -.0652)$$

$$= .2618 \text{ in}^4$$

$$M = 5660/2 \times 3.85 - 2060/2 \times (1.78 - .358)$$

$$= 10466 \text{ in-lbs}$$

$F_{bu} = 105000 \times 80/74 = 113500$ psi $F_{hu} = 80000$ psi $F_{su} = 44000$ psi

$$f_{bu} = \frac{10466 \times 1.0185}{.2618} = 40716 \text{ psi} \qquad R_{bu} = \frac{40716}{113500} = .358$$

$$f_{hu} = \frac{2060}{.1796 \times 2} = 5785 \text{ psi} \qquad R_{hu} = \frac{5786}{80000} = .072$$

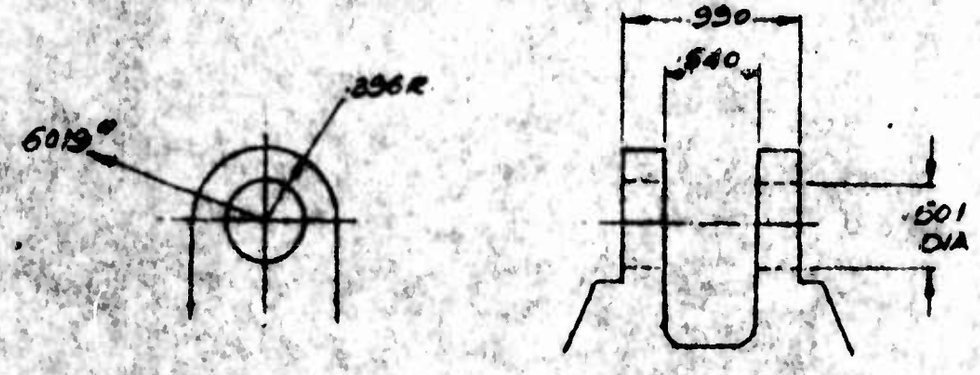
$$f_{su} = \frac{5660}{.1796 \times 2} = 15757 \text{ psi} \qquad R_{su} = \frac{15757}{44000} = .358$$

$$MS_{ult} = \frac{1}{(.358 + .072) + .358} - 1 = +.78$$

CALC			REVISED	DATE	MAIN GEAR FRAME-DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 109
APR						

TRIANGULAR FRAME CONT.

LUG @ B.



TENSION $P'_{tu} = K_t F_{tu} A_t$

W = .396 × 2 = .792

D = .501

T = .990 - .540 = .450

W/D = .792/.501 = 1.581 K_t = .98

A_t = (.792 - .501) × .450 = .221

F_{tu} = 80000 psi

P_{tu} = .98 × 80000 × .221 = 17326 LBS.

$MS_{ULT} = \frac{17326}{6019 \times 1.15} - 1 =$ + LARGE

(1.15 = FITTING FACTOR)

SHEAR-BEARING

$P'_{bru} = K_{br} F_{tu} A_{br}$

a = .396

D = .501

T = .460

a/D = .396/.501 = .790

K_{br} = .53

A_{br} = .501 × .450 = .225

P'_{bru} = .53 × 80000 × .225 = 9540 LBS

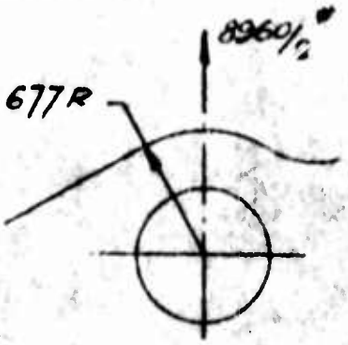
$MS_{ULT} = \frac{9540}{6019 \times 1.15} - 1 =$ + .38

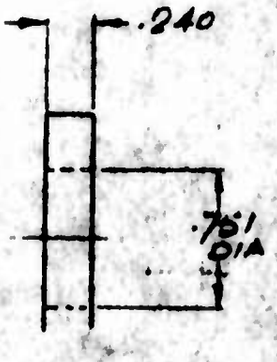
(1.15 = FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR	15101
CHECK					FRAME-DRAG BRACE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 110
APR						

TRIANGLLAR FRAME - CONT

LUG @ R.





TENSION $P'_{tu} = K_t F_{tu} A_t$

W = .677 × 2 = 1.354

D = .751

T = .240

$W/D = 1.354/.751 = 1.803$ $K_t = .975$

$A_t = (1.354 - .751) \times .240 = .145$

$F_{tu} = 80000$ psi

$P'_{tu} = .975 \times 80000 \times .145 = 11310$ LBS.

$$MS_{ULT} = \frac{11310}{8960/2 \times 1.15} - 1 = \underline{+ \text{LARGE}}$$

(1.15 — FITTING FACTOR)

SHEAR BEARING $P'_{bru} = K_{br} F_{tu} A_{br}$

a = .677

D = .751

T = .240

$a/D = .677/.751 = .901$ $K_{br} = .70$

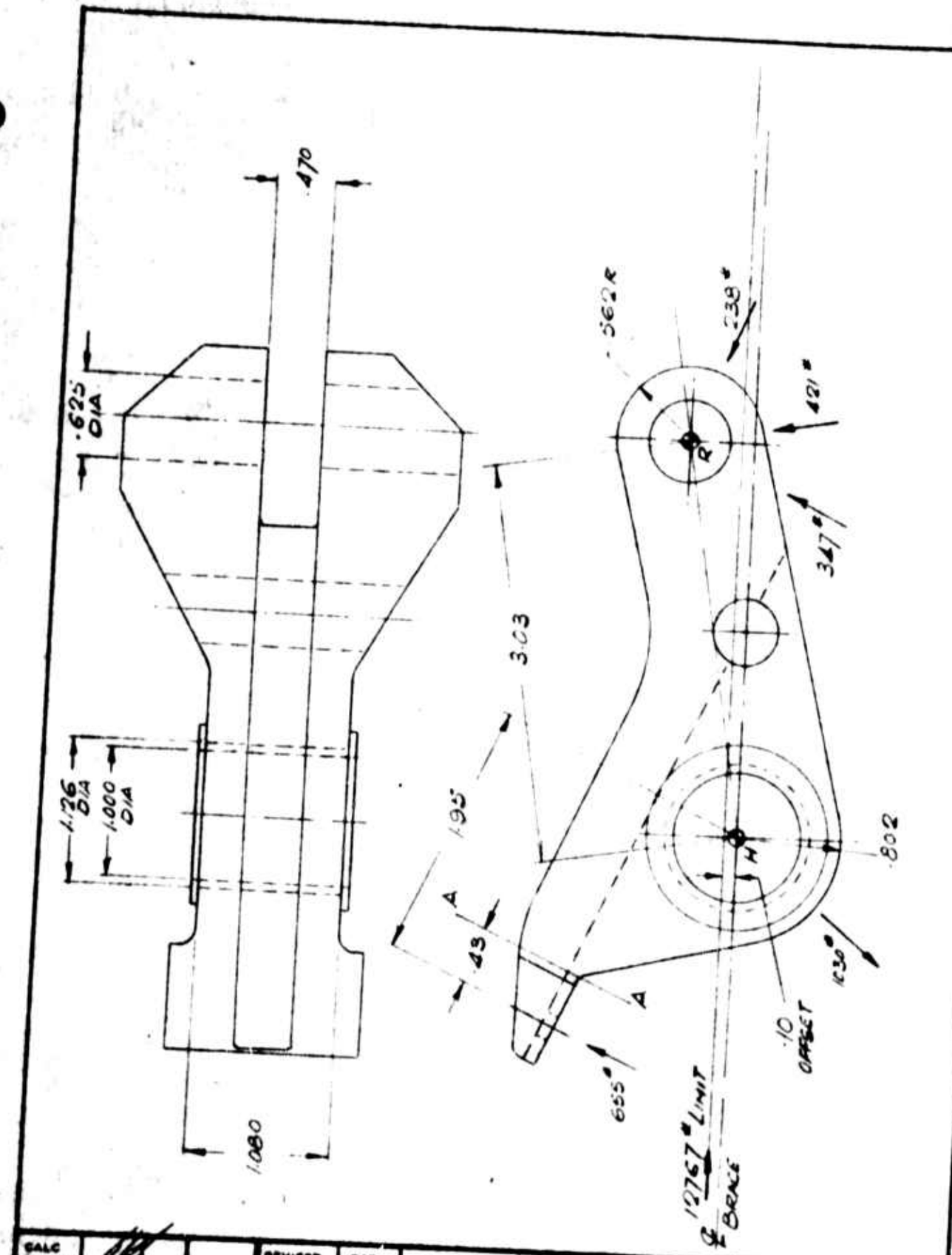
$A_{br} = .751 \times .240 = .180$

$P'_{bru} = .70 \times 80000 \times .180 = 10080$ LBS.

$$MS_{ULT} = \frac{10080}{8960/2 \times 1.15} - 1 = \underline{+.26}$$

(1.15 — FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR FRAME-DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 111
APR						



CALC			REVISED	DATE	MAIN GEAR STOP FITTING - DRAG BRACE
CHECK			•		
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA
APR					

1510L

RYAN

PAGE 111A

STOP FITTING - CONT P/N 5101228 MAT'L ALUM ALLOY 7075-T6

ROTATIONAL MOMENT OF LOWER DRAG BRACE (OH)
AT H = 12767 × 10

LOAD ON STOP = $\frac{12767 \times 10}{1.95}$ = 655 LBS

LOAD ON RETRACT CRANK BOLT (R)

= $\frac{12767 \times 10}{3.03}$ = 421 LBS

ROTATING 421 LB LOAD @ R PARALLEL & PERPENDICULAR TO 655 LB LOAD AT STOP

COS 34° 30' = .8241

SIN 34° 30' = .5664

421 × .8241 = 347 LB
421 × .5664 = 238 LB

REACTION @ H = 347 + 655 = 1002 # VERT
238 # HORIZ

RESULTANT = 1002 ⟷ 238 = 1030 LB.

CALC	[illegible]		REVISED	DATE	MAIN GEAR	15101
CHECK					STOP FITTING - DRAG BRACE	RYAN.
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 111 B
APP						

STOP FITTING · CONT

LUG AT H

TENSION

$$P'_{tu} = K_t F_{tu} A_t$$

W = 1.604

D = 1.126

T = 1.080

$$W/D = 1.604/1.126 = 1.425 \quad \therefore K_t = .99$$

$$A_t = (1.604 - 1.126) \times .80 = .516$$

$F_{tu} = 77000$ psi

$$P_{tu} = .99 \times 77000 \times .516 = 39336.48$$

$$MS_{ULT} = \frac{39335}{1.30 \times 1.50 \times 1.15} - 1 = \underline{+\text{LARGE}}$$

(1.15 = FITTING FACTOR)

SHEAR · BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

a = .802

D = 1.126

T = 1.155

$$a/D = .802/1.126 = .712 \qquad K_{br} = .38$$

$$A_{br} = 1.126 \times 1.080 = 1.216$$

$$P'_{br} = .38 \times 77000 \times 1.216 = 35580 \text{ LBS}$$

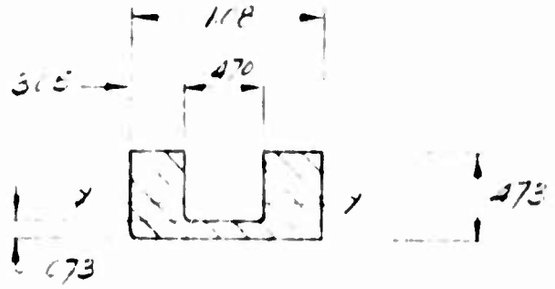
$$MS_{ULT} = \frac{35580}{1.30 \times 1.50 \times 1.15} - 1 = \underline{+\text{LARGE}}$$

(1.15 = FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR STOP FITTING · DRAG BRACE	15104
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 East Second St. Pomona, California	PAGE 111 C
APR						

STOP FITTING CONT

SECTION A-A



$M = 655 \times .43 - 282 \times .285$

$A = (1.08 \times .073) + .40 \times .01 = .0922\ in^2$

$I = \frac{2 \times .305 \times .473^3 + .47 \times .073^3}{3} - .0922 (.473 \times .30)^2 = .0119\ in^4$

$Q = 2 \times .305 \times .40 \times .10 = .0244$

$K = \frac{2 \times .0244 \times .30}{.0119} = 1.23$

$F_{bu} = 89000 \times 77/14 = 92560\ psi$

$F_{su} = 46000\ psi$

$f_{bu} = \frac{282 \times .30 \times 1.50}{.0119} = 10664\ psi$ $\quad R_b = \frac{10664}{92560} = .115$

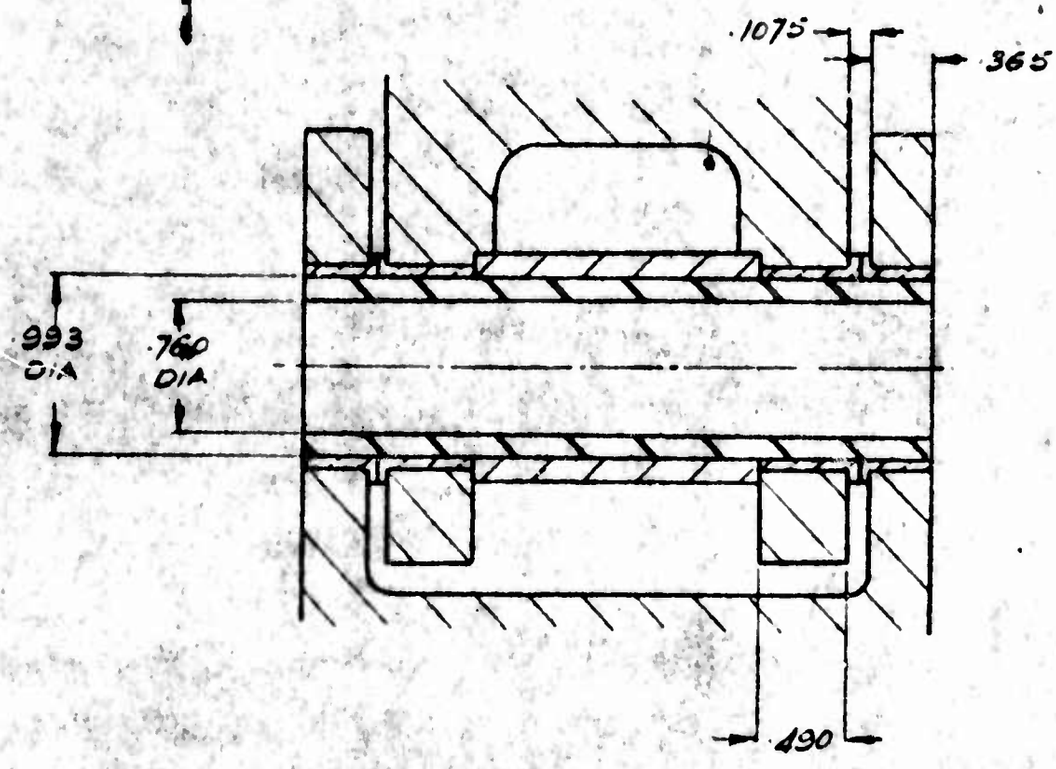
$f_{su} = \frac{655 \times 1.50}{.3228} = 3044\ psi$ $\quad F_{su} = \frac{3044}{46000} = .066$

$$MS_{ult} = \frac{1}{.115 + .066} - 1 = +\ \underline{\text{LARGE}}$$

CALC			REVISED	DATE	MAIN GEAR	15101
CHECK					STOP FITTING - DRAG BRACE	RYAN.
APP						
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 111 D

DRAG BRACE HINGE BOLT P/N 15101224 MAT'L 4340 STEEL
HEAT TREAT 180-200 KSI

CONDITION 6 CRITICAL



TENSION LOAD (P_T) = 32180 LBS REF p. 90

LOAD PER LUG = 32180/2 = 16090 LBS

POINT of MAX BENDING

$M = (.365/2 + .1075 + .490/2) \times 16090 = 8608$ IN. LBS

OD = .993	.7744		.0477
ID = .760	.4536		.0164
$2t$ = .233	A = .3208 IN^2		I = .0313 IN^4
t = .1165			

D/t = .993/.1165 = 8.52

F_{bu} = 256000 psi F_{su} = 109000 psi

$f_{bu} = \frac{8608 \times 1.50 \times .4965}{.0313} = 204818$ psi

$M.S._{ULT} = \frac{256000}{204818} - 1 = +.25$

CALC			REVISED	DATE	MAIN GEAR BOLT-HINGE	15101
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 112

DRAG BRACE HINGE BOLT - CONT

AT SHEAR FACE

$$M = (.365/2 + .1075) \times 16090 = 4666 \text{ IN. LBS}$$

$$f_{bu} = \frac{4666 \times 1.50 \times .4965}{.0313} = 111022 \text{ psi} \qquad R_{bu} = \frac{111022}{256000} = .434$$

$$f_{su} = \frac{16090 \times 1.50}{.3208} = 75234 \text{ psi} \qquad R_{su} = \frac{75234}{109000} = .690$$

$$MS_{ULT} = \frac{1}{.434 + .690^{1.5}} - 1 = \underline{+.11}$$

FITTING FACTOR

BEARING of BOLT IN BUSHING (OUTER LUGS) P/N 1510L215-11

MAT'L ALUM BRONZE AMS 4681

$F_{br} = 101000$ psi

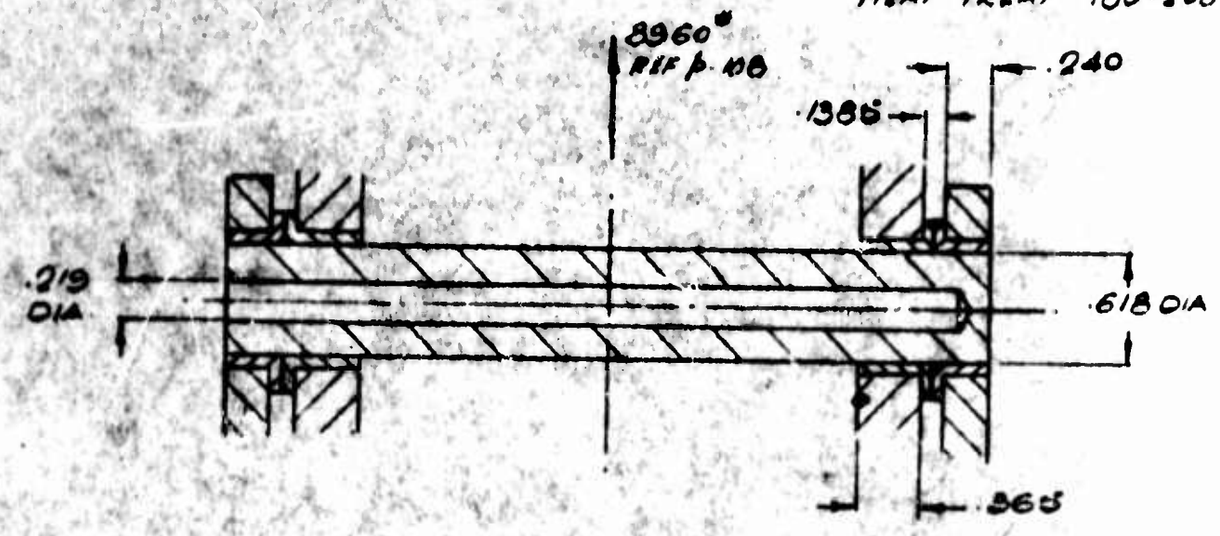
AREA $= .365 \times .993 = .3624$ in^2

$$f_{br} = \frac{16090 \times 1.50}{.3624} = 66598 \text{ psi}$$

$$MS_{ULT} = \frac{101000}{66598} - 1 = \underline{+.52}$$

CALC			REVISED	DATE	MAIN GEAR BOLT - HINGE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 113
APR						

ATTACH^MT BOLT @ R P/N 15101225 MAT'L STEEL 4340 HEAT TREAT 180-200



POINT of MAX. BENDING

$M = (.240/2 + .1385 + .365/2) \times 8960/2 = 1976$ IN. LBS.

O.D. = .618
I.D. = .219
2t = .399
t = .1995

A = .3000 + .0377 + .2623 IN²

I = .0072 + .0001 = .0071 IN⁴

$D/t = .618/.1995 = 3.098$

$F_{bu} = 300000$ psi $F_{su} = 109000$ psi

$f_{bu} = \frac{1976 \times .309}{.0071} = 85998$ psi

$MS_{ULT} = \frac{300000}{85998} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR BOLT - UPPER SEGMENT	15101
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 897 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 114
APR						

ATTACH NUT BOLT @ R - CONT.

AT SHEAR FACE

$M = (.240/2 + .1383) \times 8960/2 = 1158$ IN LBS

$f_{bu} = \frac{1158 \times 309}{.0071} = 50397$ psi $\qquad R_{bu} = \frac{50397}{300000} = .168$

$f_{su} = \frac{8960}{.2623 \times 2} = 17080$ psi $\qquad R_{su} = \frac{17080}{109000} = .157$

$$MS_{ULT} = \frac{1}{.168 + .157(1.15)} - 1 = + \text{LARGE}$$

(1.15 — FITTING FACTOR)

BEARING of BOLT in BUSHING. P/N 1510L215-18

$F_{bu} = 101000$ psi

Mat'l ALUM BRONZE AMS 4681

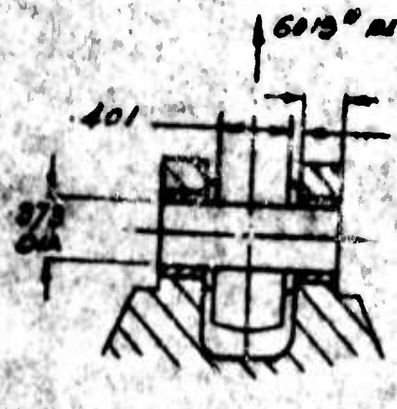
AREA $= .618 \times .240 = .1483$ IN.^{2}

$f_{br} = \frac{8960}{.1483 \times 2} = 30209$ psi

$MS_{ULT} = \frac{101000}{30209} - 1 = + \text{LARGE}$

CALC	[illegible]		REVISED	DATE	MAIN GEAR BOLT - UPPER SEGMENT	15106
CHECK						RYAN.
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 115
APR						

ACTUATOR BOLT P/N 5101226 MAT'L STEEL 4140 180-200 HEAT TREAT



POINT of MAX BENDING

$M = (.225/2 + .0496 + .401/4) \times 6019/2 = 788$ IN. LBS

$A = .1092$ IN.^{2} $I = .00097$ IN.^{4}

$F_{bu} = 300000$ psi $F_{su} = 109000$ psi

$f_{bu} = \frac{788 \times .1868}{.00097} = 151546$ psi

$MS_{ULT} = \frac{300000}{151546} - 1 = +.98$

AT SHEAR FACE

$M = (.225/2 + .0495) \times 6019/2 = 488$ IN. LBS

$f_{bu} = \frac{488 \times .1865}{.00097} = 93814$ psi $R_{bu} = \frac{93814}{300000} = .313$

$f_{su} = \frac{6019}{.1092 \times 2} = 27560$ psi $R_{su} = \frac{27560}{109000} = .252$

$MS_{ULT} = \frac{1}{.313 + .252(1.25)} - 1 = +.LARGE$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR BOLT - ACTUATOR.	1510L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 116
APP						

ACTUATOR BOLT - CONT.

BEARING of BOLT IN BUSHING P/N 1510L213-11

Mat'l ALUM BRONZE
AMS 4681

F_{br} = 101000 psi

AREA = .373 × .226 = .0839 in²

$f_{br} = \frac{6019}{.0839 \times 2} = 35870$ psi

$MS_{ULT} = \frac{101000}{35870} - 1 = +\text{LARGE}$

CALC			REVISED	DATE	MAIN GEAR BOLT - ACTUATOR	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 567 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 117

RETRACTION CYLINDER 1510L300

BASIC DATA

1. 3000 PSI OPERATING PRESSURE
2. 4500 PSI PROOF PRESSURE
3. 7500 PSI BURST PRESSURE
4. CYLINDER BORE = 1.304 IN. = 1.335 IN.
5. PISTON ROD O.D. = .622 IN. = .304 IN.

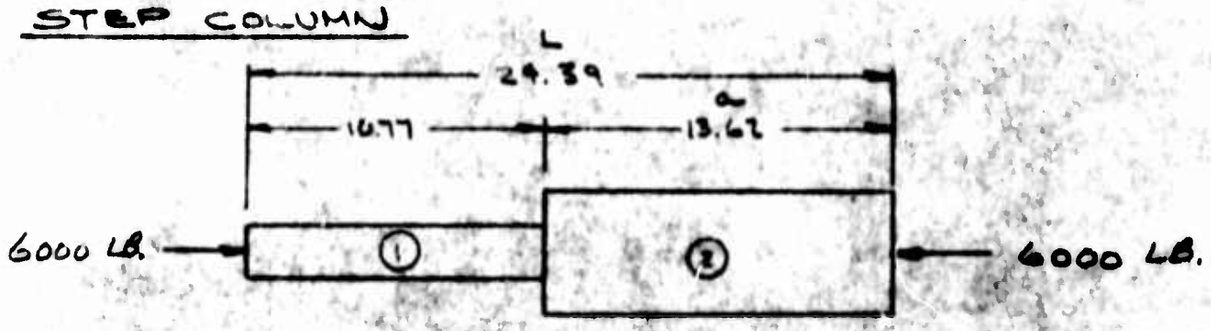
MAX. COMP. LOAD = 3000 X 1.335 = 4000 LB. LIMIT
= 6000 LB. ULT.

MAX. TENSION LOAD = 3000 (1.335 - .304) = 3100 LB LIMIT
= 4650 LB. ULT.

CALC	[signature]		REVISED	DATE	MAIN GEAR RETRACTION CYLINDER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 118
APR						

RETRACTION CYLINDER

STEP COLUMN



① CYLINDER - ALUM

O.D. = 1.532 .763
I.D. = 1.304 .142
.121 IN.⁴

$EI_1 = 10500000\ (.121) = 1270500$

② PISTON — STEEL

O.D. = .620 .0073
I.D. = .307 .0004
.0069 IN.⁴

$EI_2 = 29000000\ (.0069) = 200100$

$\frac{EI_2}{EI_1} = .16 \qquad \frac{a}{L} = .56 \qquad \therefore P_{CR} = .29$

$P_{CR} = \frac{.29(\pi^2)\ 1270500}{(24.39)^2} = 6120$ LB.

$M.S. = \frac{6120}{6000} - 1 = .02$

CALC	Frankel		REVISED	DATE	MAIN GEAR RETRACTION CYLINDER	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 807 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 119

CYLINDER — 2024-T4 ALUM
1510L-301

HOOP TENSION

$f_{hc} = \frac{P D_H}{2t}$

O.D. = 1.522 IN
I.D. = 1.304

$f_{hc} = \frac{7500 \times 1.413}{.218} = 48620$ psi

$F_{tu} = 70000$ psi

$M.S. = \frac{70000}{48620} - 1 = .44$

PISTON — 4340 — 1510L 303
180/200 KSI

HOOP COMPRESSION

O.D. = .620
I.D. = .307

$f_{hc} = \frac{7500 \times .4685}{.313} = 11100$ psi (NOT CRITICAL)

CALC	Lambert		REVISED	DATE	MAIN GEAR RETRACTION CYLINDER	1510L RYAN
CHECK						
APP						
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 120

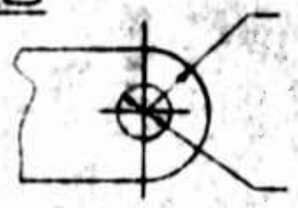
CYLINDER HEAD

15IOL 302
707½-T6 ALUM

P_T = 4650 LB.

P_C = 6000 LB.

LUG END



a = .437 a/D = .87 K_{br} = .65
w/D = 1.76 K_t = .98
t = .200 EACH $A_{br} = D t$ = .100
D = .500 $A_t = (w-D)t$ = .075

SHEAR - BEARING

$P_{br} = K_{br} A_{br} F_{tu}$

= .65 (.100) 70000 = 4550 LB.

$$M.S. = \frac{2(4550)}{(1.15)4650} - 1 = .70$$

TENSION

$P_{tu} = K_t A_t F_{tu}$

= .98 (.075) 70000 = 5140 LB.

$$M.S. = \frac{2(5140)}{(1.15)4650} - 1 = .92$$

CALC	Lambert		REVISED	DATE	MAIN GEAR RETRACTION ACTUATOR	15IOL
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 121
APR						

BOLT NAS 501-3-5A

SEAL DIA. = 1.504 IN. = 1.777 IN.^{2}

$P = 7500\ (1.777) = 13330$ LBS.

$P/\text{BOLT} = 13330 / 4 = 3330$ LBS.

P_T ALLOWABLE = 7390 LBS.

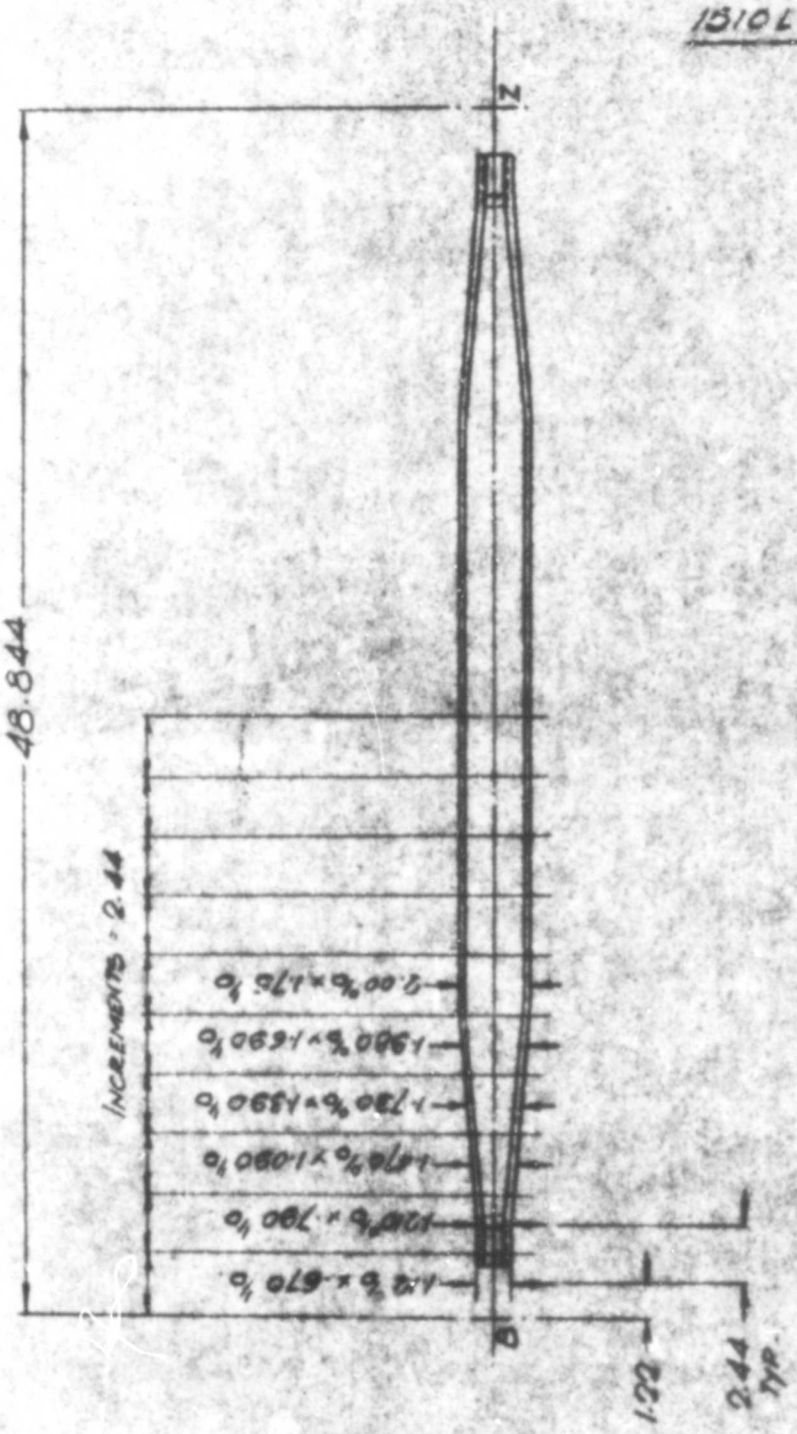
$$M.S. = \frac{7390}{3330} - 1 = \underline{1.22}$$

CALC	Lambert		REVISED	DATE	MAIN GEAR	1510L
CHECK					RETRACTION ACTUATOR	RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 122
APR						

TUBE P/N 1510L501

MAT'L ALUM. ALLOY 2014-T6

1510L500 ASSY.



CALC			REVISED	DATE
CHECK				
APP				
APP				

MAIN GEAR

TUBE - SIDE BRACE

1510L

RYAN

H. W. LOUD MACHINE WORKS, INC.
867 EAST SECOND ST., POMONA, CALIFORNIA

PAGE 123

TUBE - CONT.

P(0·2) = 19298 LBS - TENSION CONDITION 38

P(0·2) = 7805 LBS - COMPRESSION CONDITION 10

COLUMN CHECK.

$$P_{CR} = \frac{(320) \times .9}{L^2 \Sigma_0^L \frac{K}{EI}}$$ — REF 05.4 DOUGLAS AIRCRAFT STRESS MANUAL

L = 48.844

MEMBER IS SYMMETRICAL ABOUT ITS MID-POINT

INCREMENT = 48.844/20 = 2.44 IN. LONG.

INCREMENT	K	I MID-POINT	E	$\frac{E}{EI} \times 10^{-6}$
1	.020	.067	10.5×10^6	.028
2	.177	.086	"	.196
3	.476	.160	"	.283
4	.887	.257	"	.329
5	1.370	.354	"	.369
6	1.879	.325	"	.551
7	2.362	.325	"	.692
8	2.773	.325	"	.812
9	3.072	.325	"	.900
10	3.229	.325	10.5×10^6	.946

$\Sigma = 5.106$

$$\Sigma_0^L \frac{K}{EI} = \frac{2 \times 5.106}{10^6}$$

$$P_{CR} = \frac{320 \times 10^6 \times .9}{(48.844)^2 \times 10.212} = \frac{288 \times 10^6}{24368} = 11803 \text{ LBS}$$

$$MS_{ULT} = \frac{11803}{7805 \times 1.50} - 1 = \underline{+.01}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR TUBE - SIDE BRACE	15101
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 124
APR						

TUBE - CONT.

MINIMUM SECTION = 1.12 $^{0}/_{01A}$ x .670 $^{1}/_{01A}$

AREA = .6326 IN.^{2}

F_{tu} = 64000 psi

P(0.2) = 19298 LBS.

$f_t = \frac{19298 \times 1.50}{.6326} = 45759$ psi

$MS_{ULT} = \frac{64000}{45759} - 1 = +.40$

SHEAR ACROSS THREADS

PITCH DIA of THREAD = .7086 MIN.

MIN LENGTH of THREAD = 1.00.

$f_{su} = \frac{19298}{.7056 \times 1.0/_2 \times \pi} = 17409$ psi

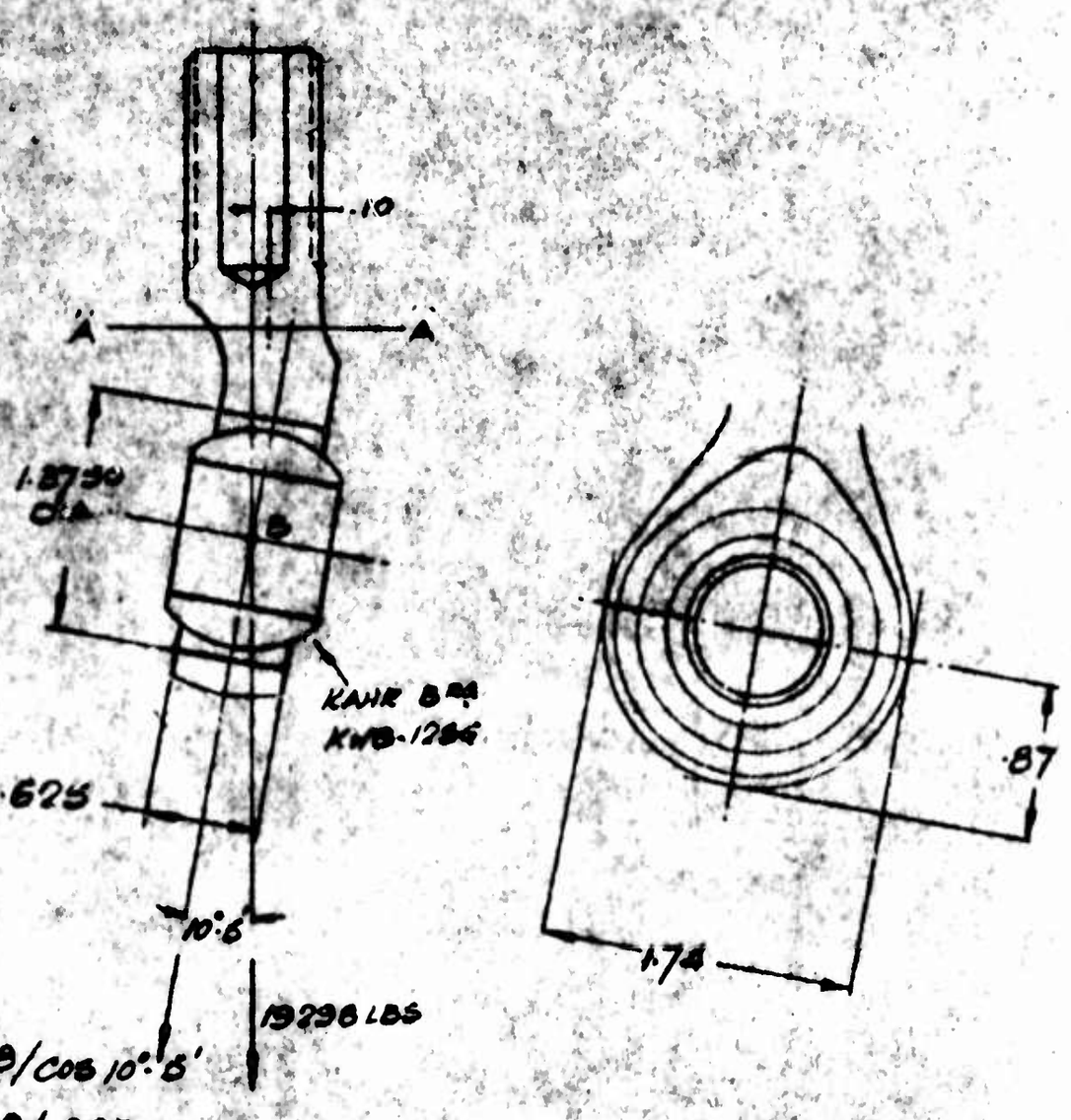
F_{su} = 35000 psi

$MS_{ULT} = \frac{35000}{17409} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR	15106
CHECK					TUBE - SIDE BRACE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 125
APR						

ROD END P/N 1510L302 MAT'L 4330 STEEL

HEAT TREAT 220-240 KSI



CALC			REVISED	DATE	MAIN GEAR ROD END - ANGLE	1510L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 667 EAST SOTENO ST., POMONA, CALIFORNIA	PAGE 126
APP						

ROD END - CONT

TENSION

$P'_{tu} = K_t F_{tu} A_t$

W = 1.74

D = 1.3750

T = .625

$W/D = 1.74/1.375 = 1.265 \quad \therefore K_t = .99$

$A_t = (1.74 - 1.375) \times .625 = .228$

$F_{tu} = 220000$ psi

$P'_{tu} = .99 \times 220000 \times .228 = 49658.16$

$MS_{ULT} = \dfrac{49658}{19630 \times 1.50 \times 1.15} - 1 = \underline{4.46}$

(FITTING FACTOR)

SHEAR - BEARING

$P'_{bru} = K_{br} F_{tu} A_{br}$

a = .87

D = 1.3750

T = .625

$a/D = .87/1.375 = .633 \quad \therefore K_{br} = .96$

$A_{br} = .1375 \times .625 = .859$

$F_{tu} = 220000$ psi

$P'_{bru} = .96 \times 220000 \times .859 = 49136.16$

$MS_{ULT} = \dfrac{49136}{19630 \times 1.50 \times 1.15} - 1 = \underline{4.46}$

(FITTING FACTOR)

CALC			REVISED	DATE	MAIN GEAR ROD END - ANGLE	NO.
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 187
APR						

LOADING OF INTERNAL COMPONENTS

1. LOAD DUE TO F.C. AIR PRESSURE ACTING BETWEEN CYLINDER I.D. AND PISTON O.D.

$P = 1816 \left[.7854 (3.370^2 - 2.746^2)\right] 1.6 = 8170$ LB.

2. THREE TIMES F.E. AIR PRESSURE ACTING ON CYLINDER I.D.

$P = 3 (126)(1.6)(.7854 \times 3.370^2) = 5060$ LB.

3. THREE TIMES F.E. AIR PRESSURE ACTING ON PISTON HEAD AREA.

$P = 3 (126)(1.5)(.7854 \times 3.063^2) = 4180$ LB.

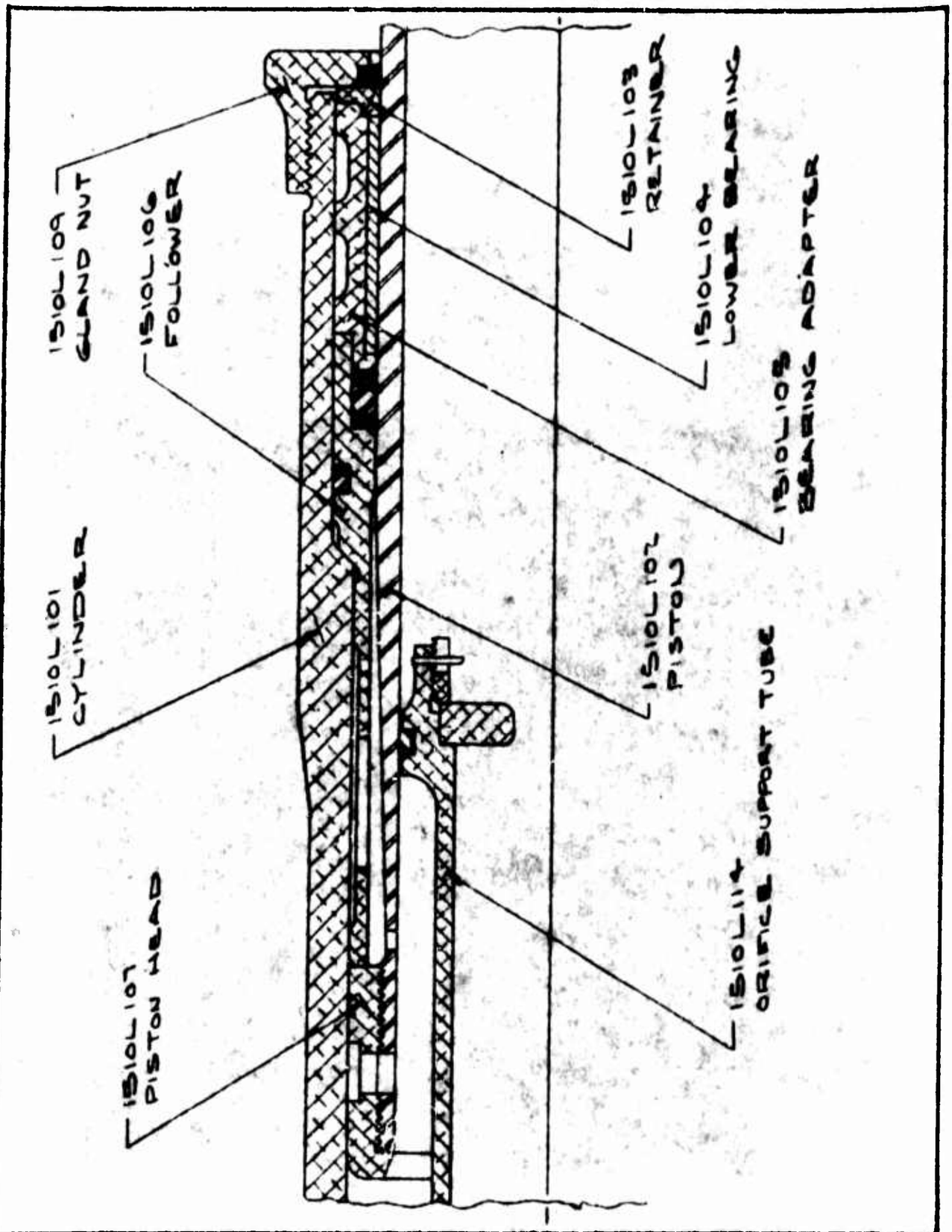
4. TWENTY TIMES UNSPRUNG WT.

$P = 20 (51) = 1020$ LB.

5. COEFFICIENT OF FRICTION TIMES MAX UPPER BEARING REACTION.

$P = .15 (20650) 1.5 = 4650$ LB.

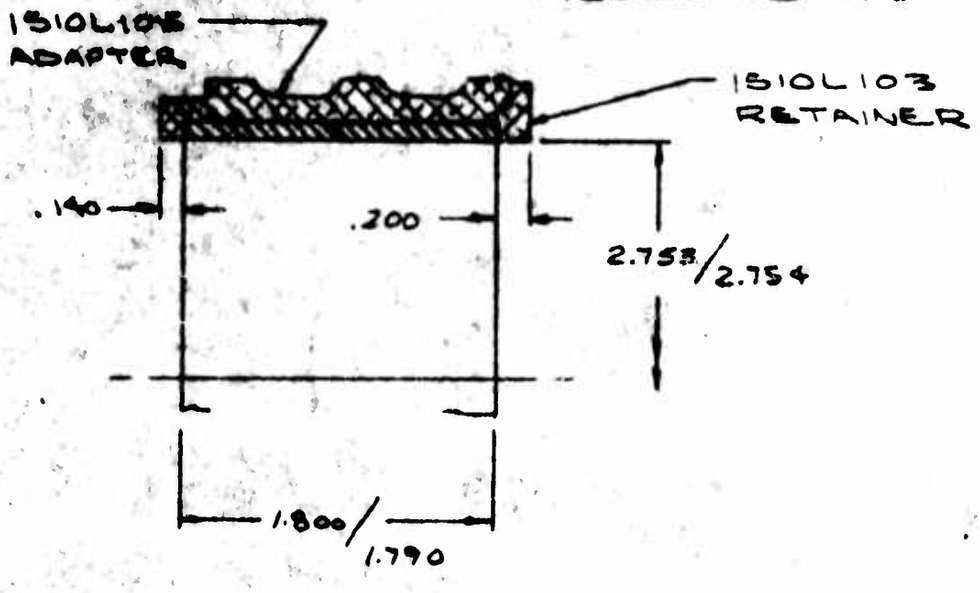
CALC	[illegible]		REVISED	DATE	MAIN GEAR KV-5A	1510L
CHECK					INTERNAL COMPONENTS	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 129



CALC	Lambert		REVISED	DATE	MAIN GEAR XV-5A — 1510L
CHECK					INTERNAL COMPONENTS — RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 East Second St., Pomona, California — PAGE 130
APR					

LOWER BEARING — 1510L104

FILLED TEFLON



CONDITION 2 PT. T.D. - S.B. (GEAR FWD.)

R_{LB} = 35230 LB LIMIT REF p. 36

$A_{L.E.}$ = 2.763 (1.790 + .140 + .200) = 5.864 IN.²

$f_{bry} = \frac{35230}{5.864} = 6000$ psi

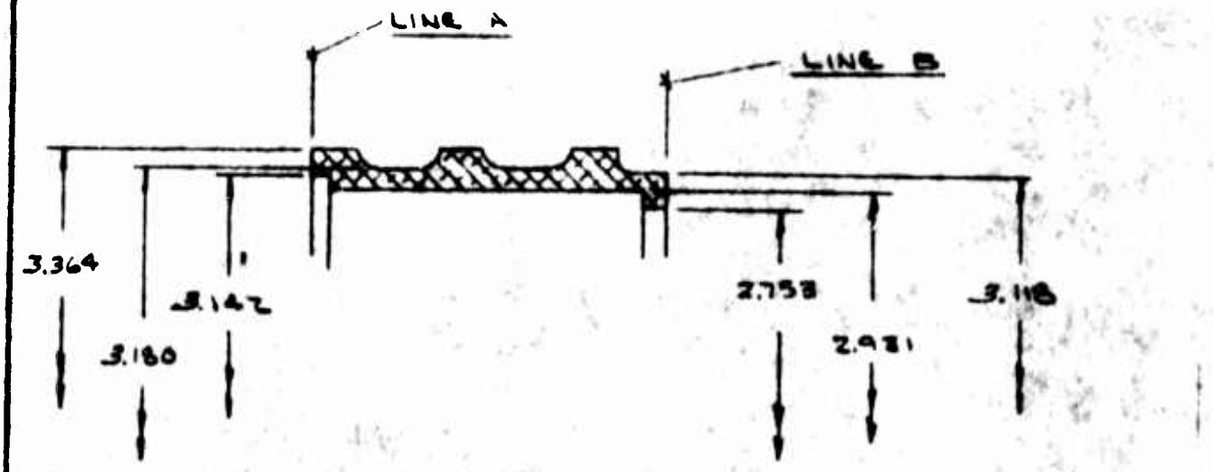
F_{bry} = 6000 psi (REF. MIL-S-8552 A)

$M.S. = \frac{6000}{6000} - 1 = \underline{0}$

CALC	Lambert		REVISED	DATE	MAIN GEAR XV-5A LOWER BEARING	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 131

BEARING ADAPTER 1510L103

2024-T4 ALUM ALLOY



P_{COMP} = 8170 LB. ULT.
P_A = 8170 LB. ULT
P_B = 5060 LB. ULT.

F_{bru} = 108000 psi
F_{bry} = 73000 psi
F_c = 50000 psi

A_{br} LINE A = .7854 $(3.258^2 - 3.142^2)$ = 1.103 IN.^{2} REF. 1510L103

A_{br} LINE B = .7854 $(3.364^2 - 3.190^2)$ = .895 IN.^{2} REF. 1510L106

A = .7854 $(3.180^2 - 2.931^2)$ = 1.194 IN.^{2}

$f_c = \frac{8170}{1.190}$ = 6870 psi (NOT CRITICAL)

$f_{br_A} = \frac{8170}{1.103}$ = 7410 psi (NOT CRITICAL)

$f_{br_B} = \frac{5060}{.895}$ = 5650 psi (NOT CRITICAL)

CALC	Lambert		REVISED	DATE	MAIN GEAR, XV-5A	1510L
CHECK					BEARING ADAPTER	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 132

FOLLOWER 1510L106

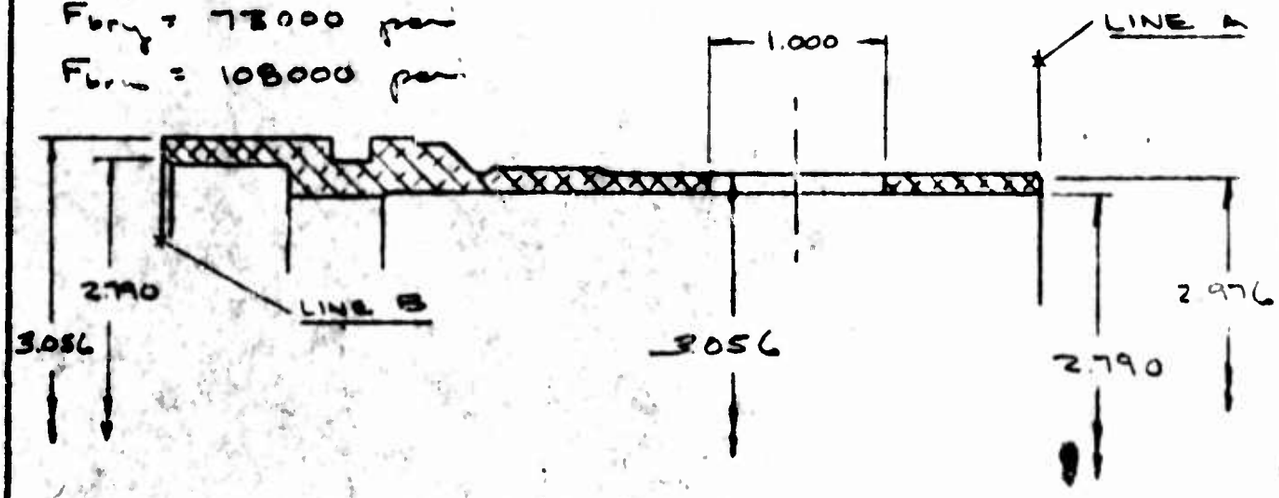
2024-T4 ALUM ALLOY

$P_{COMP.} = 5060$ LB. ULT.

$F_{cy} = 50000$ psi

$F_{bry} = 78000$ psi

$F_{bru} = 108000$ psi



BEARING AT LINE A

$A_{br_A} = .7854\left(2.976^2 - 2.790^2\right) = .842 \text{ IN.}^2$

$f_{br} = \frac{5060}{.842} = 6010 \text{ psi}$ (NOT CRITICAL)

$A_{br_B} = .7854\left(3.364^2 - 3.190^2\right) = .895 \text{ IN.}^2$

$A = .7854\left(3.056^2 - 2.790^2\right) - 4(1.000)(.086) = .877 \text{ IN}^2$

$f_c = \frac{5060}{.877} = 5770 \text{ psi}$ (NOT CRITICAL)

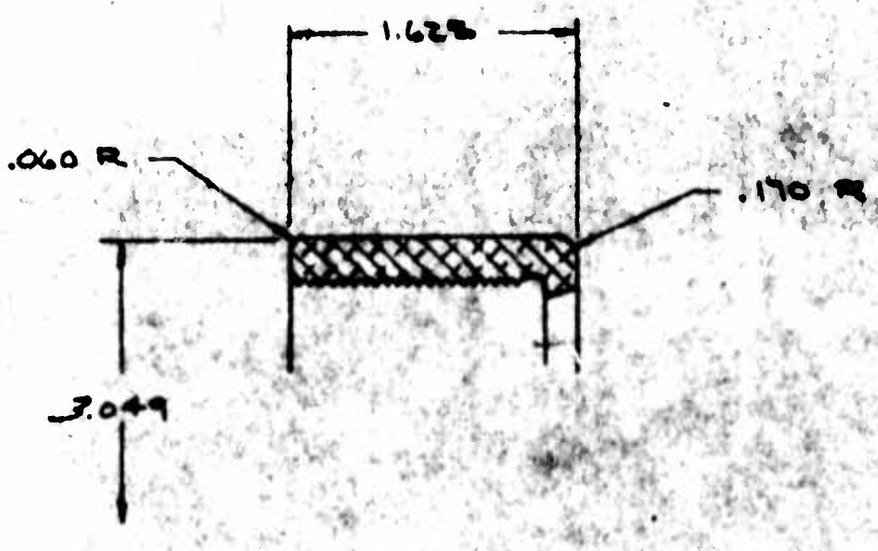
CALC	Lambert		REVISED	DATE	MAIN GEAR XV-5A FOLLOWER	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 133
APR						

PISTON HEAD

1510L107

7079-T6 ALUM ALLOY

R_{UB} = 20650 LB. LIMIT Ref p 36



L = 1.615 - .070 - .180 = 1.365 IN.

A_{br} = 3.049 (1.365) = 4.162 IN.²

F_{br} = 6000 psi

$f_{br_y} = \frac{20650}{4.162}$ = 4960 psi

$M.S. = \frac{6000}{4960} - 1 = .21$

CALC	Kimball		REVISED	DATE	MAIN GEAR XV-5A	1510L
CHECK					PISTON HEAD	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 667 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 134
APR						

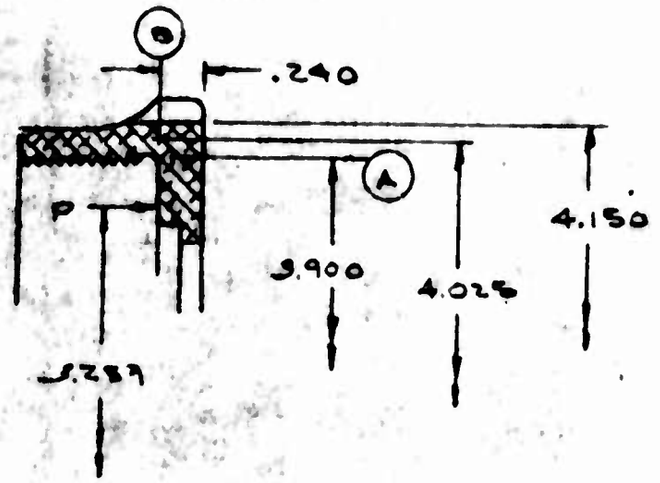
GLAND NUT

1510L 109

2014-T6 ALUM ALLOY

P = 8170 LB ULT.

F_{tu} = 65000 psi



SECTION A

$$M = 8170\left(\frac{3.900 - 3.239}{2}\right) = 8170\,(.3304) = 2700 \text{ IN-LB}$$

$$I = \frac{b h^3}{12} \qquad h = .240 \text{ IN} \qquad b = \pi\, 3.900 = 12.252 \text{ IN.}$$

$$I = \frac{12.252 \times .240^3}{12} = .0141 \text{ IN.}^4 \qquad A = \pi\, 3.900(.240) = 2.940$$

$$f_{b_u} = \frac{2700 \times .120}{.0141} = 22910 \text{ psi} \qquad R_b = .249$$

K = 1.6 $\qquad F_{bu}$ = 92000 psi $\qquad F_{su}$ = 58000 psi

$$f_{s_u} = \frac{8170}{2.940} = 2770 \text{ psi} \qquad R_s = .073$$

$$M.S. = \frac{1}{.249 + .073} - 1 = 2.84$$

CALC	[signature]		REVISED	DATE	MAIN GEAR XV-5A GLAND NUT	1510L RYAN
CHECK						
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 135

GLAND NUT CONT

SECTION B

LOAD PER INCH AT P = $\frac{9170}{\pi\ 3.239}$ = 800 LB/IN.

MOMENT PER INCH AT SECTION = $800\left(\frac{4.026 - 3.239}{2}\right)$

M = 314 $\frac{\text{IN-LB.}}{\text{IN.}}$

ONE INCH AT 3.239 DIA = $1\left(\frac{4.026}{3.239}\right)$ = 1.243 IN. AT 4.025 DIA.

$f_{t_w} = \frac{800}{1.243\ (4.150 - 3.900)}$ = 2670 psi R_t = .040

$I = \frac{1.243 \times .250^3}{12}$ = .0016 IN.^{4}

$f_{b_w} = \frac{314 \times .125}{.0016}$ = 24380 psi R_b = .265

$M.S. = \frac{1}{.040 + .265} - 1$ = 2.28

CALC	Lambert		REVISED	DATE	MAIN GEAR XV-5A	1610 L
CHECK					GLAND NUT	RYAN
APP						
APP					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 136

GLAND NUT CONT

THREAD SHEAR

P. DIA = 3.834 IN.

ENGAGEMENT = .50 IN.

$A_{SH} = \pi (3.834)(.50).5 = 3.011$ IN.^{2}

$f_{SH} = \frac{8170}{3.011} = 2710$ psi (NOT CRITICAL)

RADIAL STRESS ON THREADED RING

$f_{tc} = .0919 \frac{P}{l t_o}$

$l = .50$

$t_o = (4.150 - 3.834)/2 = .158$ IN.

$f_{tc} = .0919 \left(\frac{8170}{.50 \times .158} \right) = 9500$ psi (NOT CRITICAL)

CALC	Lindahl		REVISED	DATE	MAIN GEAR XV-5A	1510L
CHECK					GLAND NUT	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 137

ORIFICE SUPPORT TUBE

1510L114

2024-T4 ALUM

ASSUME MAX VERTICAL TO BE REACTED BY SUPPORT TUBE.

P_v = 11780 LB. (2 PT.-L.-G.B. - GEAR FWD)
(REF p 35)

O.D. = 1.950 — 2.405 — .460
I.D. = 1.510 — 1.791 — .255
.614 IN.^{2} — .206 IN.^{4}

ASSUME FIXED ENDS $\therefore L' = \frac{L}{\sqrt{C}}$ $C = 4$

L = 12.50 IN.

L' = 4/2 = 6.25 IN. F_{cy} = 50000 psi

$\rho = \sqrt{\frac{I}{A}} = \sqrt{\frac{.205}{.614}} = .578$ $L'/\rho = 10.813$

$F_c = F_{co}\left[1 - .385\,(L'/\rho)/\pi\sqrt{E/F_{co}}\right]$

$F_{co} = F_{cy}\left[1 + \frac{F_{cy}}{200000}\right] = 50000\left[1 + \frac{50000}{200000}\right] = 62500$ psi

$F_c = 62500\left[1 - \frac{(.385)(10.813)}{\pi\sqrt{10.6 \times 10^6/62500}}\right] = 56120$ psi

$f_c = \frac{1.5 \times 11780}{.614} = 28780$ psi

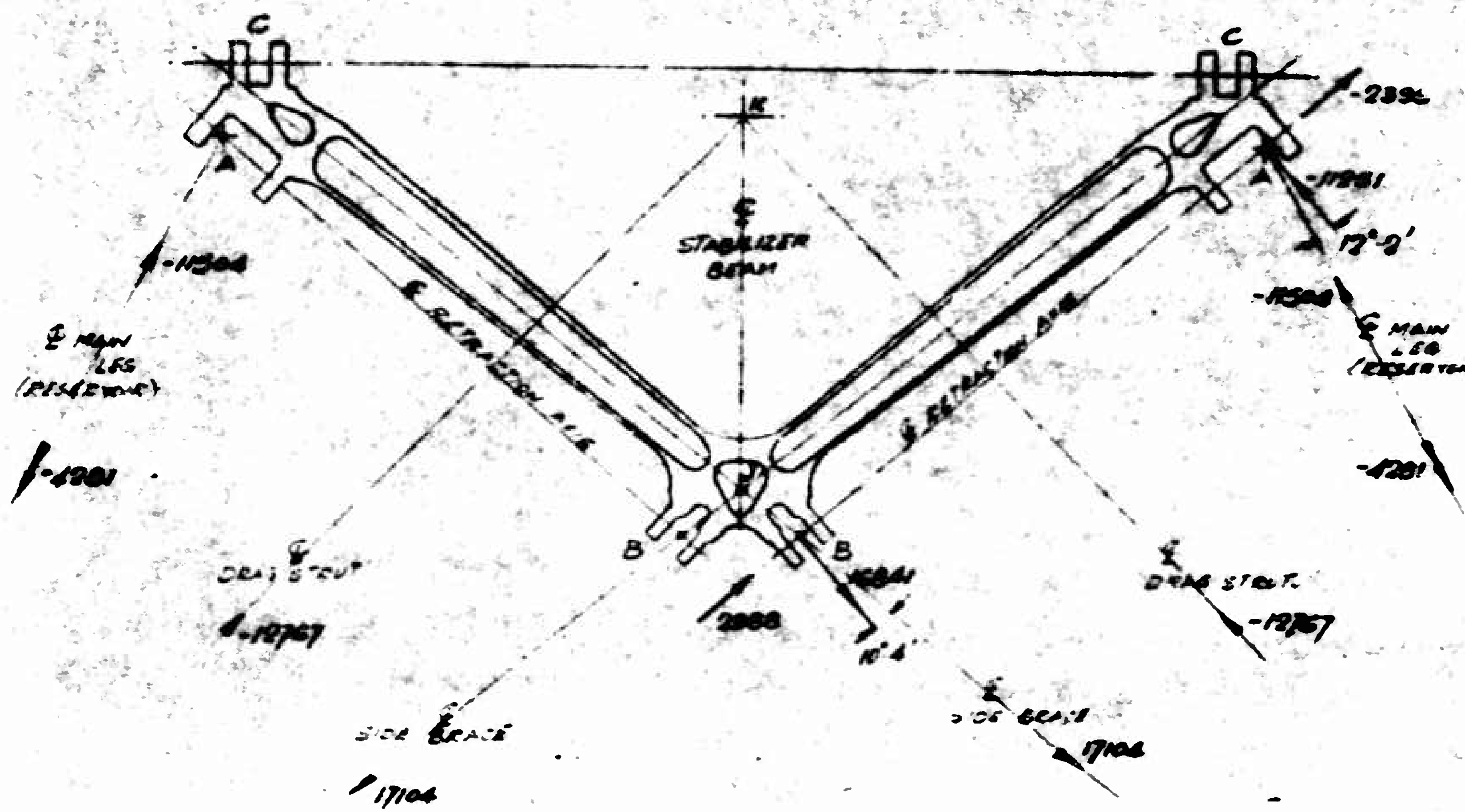
$M.S. = \frac{56120}{28780} - 1 = .95$

CALC			REVISED	DATE	MAIN GEAR XV-5A	1510L
CHECK					ORIFICE SUPPORT TUBE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 138
APR						

1510L 400 ASSY

P/N 1510L 401

CONDITION: 1



CALC			REVISED	DATE
CHECK				
APR				
APR				

MAIN GEAR

VEE BRACE

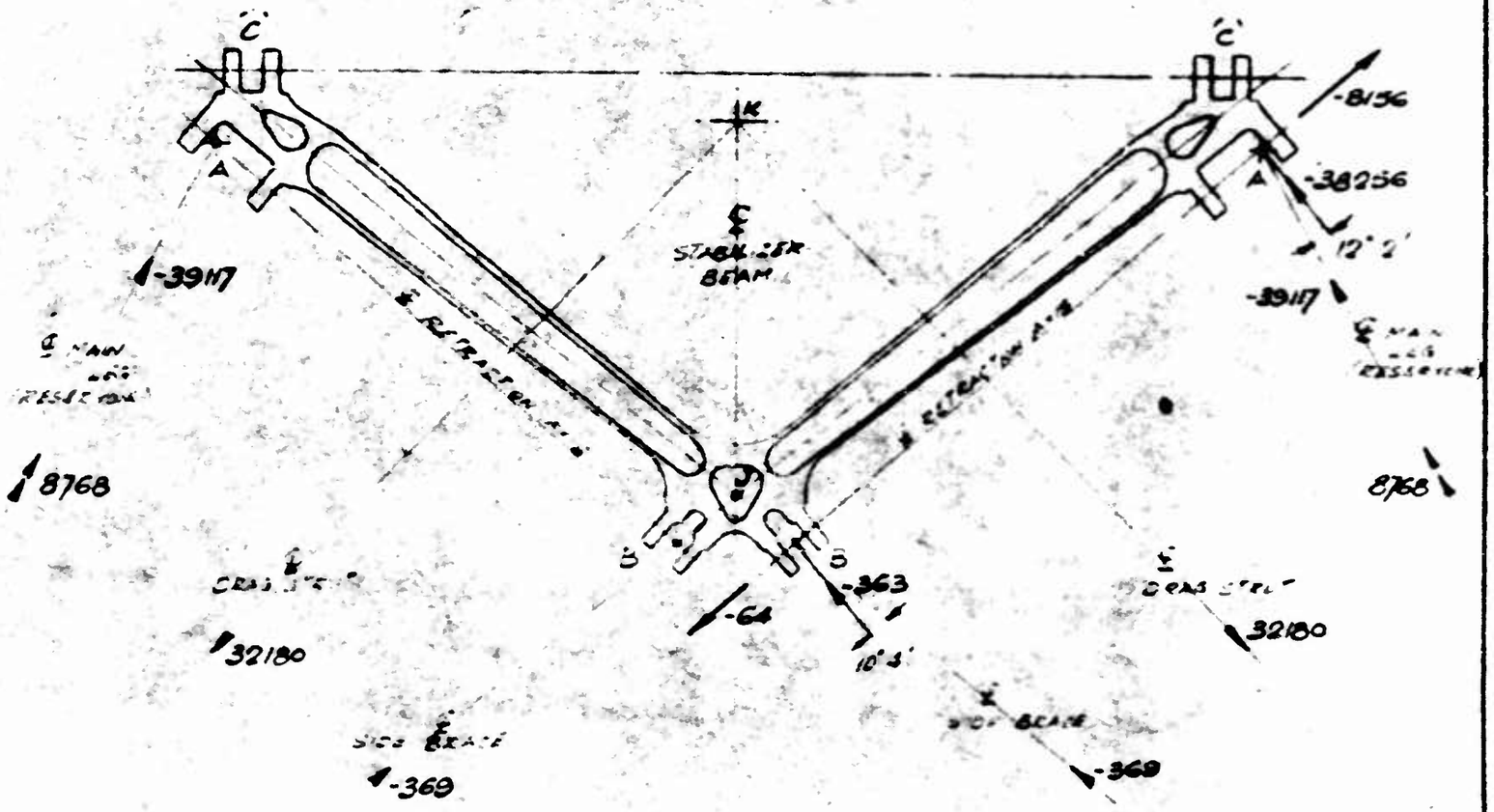
H W LOUD MACHINE WORKS INC.
887 EAST SECOND ST. POMONA, CALIFORNIA

1510L

RYAN

PAGE 139

CONDITION: 6

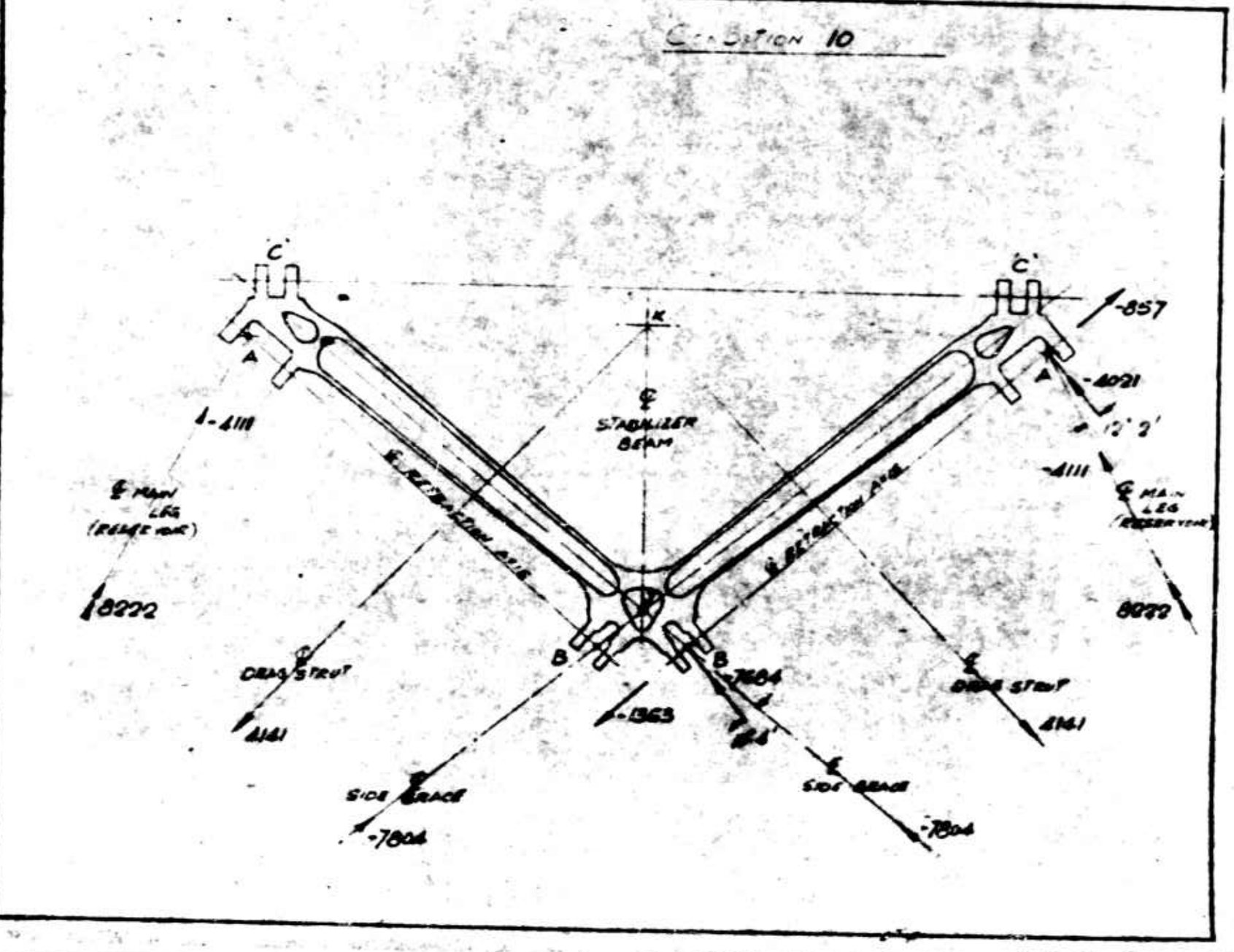


CALC	CHECK	APP	APP

REVISED	DATE

H W LOUD MACHINE WORKS INC
887 EAST SECOND ST POMONA CALIFORNIA

PAGE 140



CALC		REVISED	DATE
CHECK			
APP.			
APP.			

MAIN GEAR

VEE BRACE

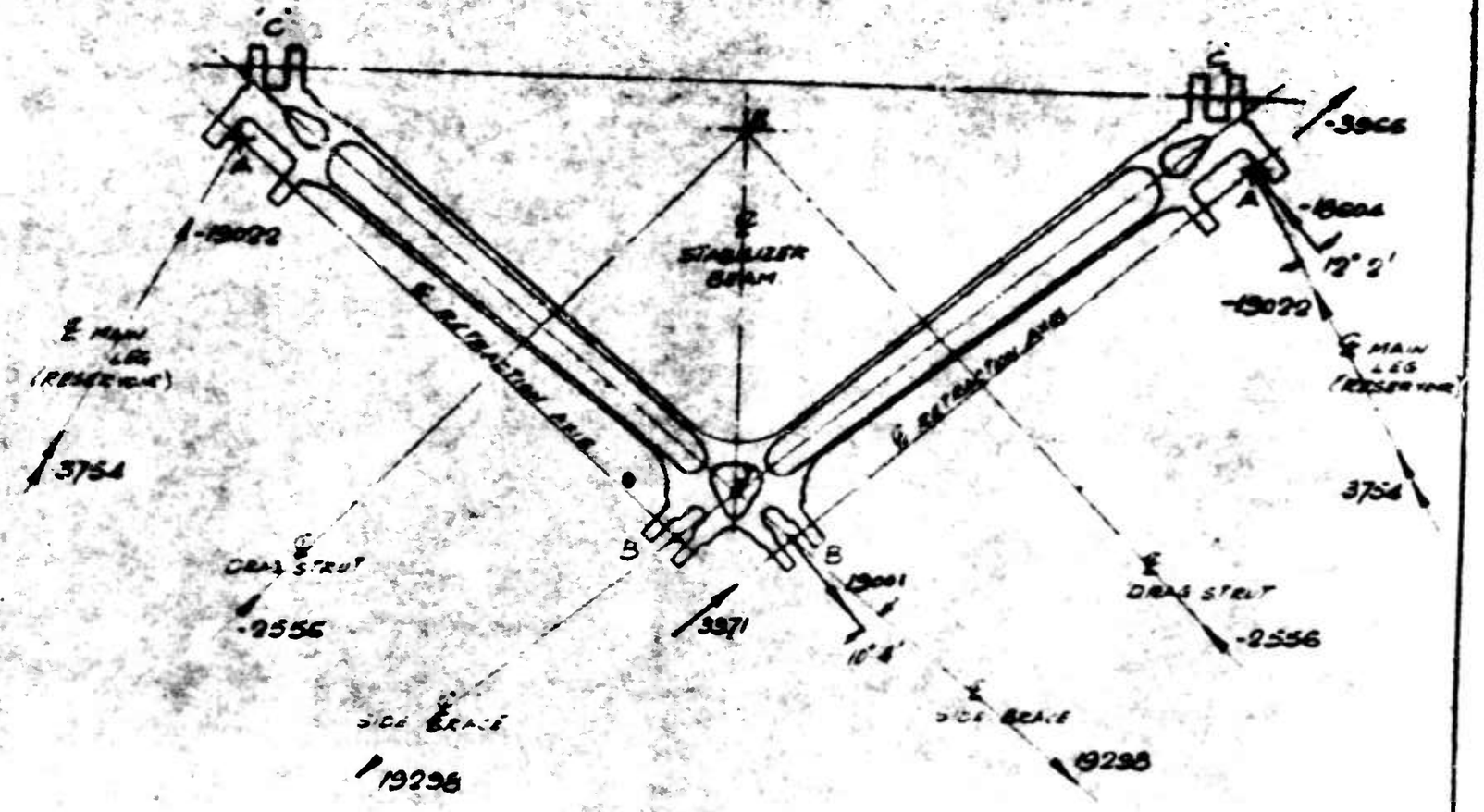
H W LOUD MACHINE WORKS, INC.
887 EAST SECOND ST. POMONA, CALIFORNIA

15104

REPORT

PAGE 141

CONDITION: 3B



CHKD			CASE
APP.			
APP.			
		REVISED	
		DATE	

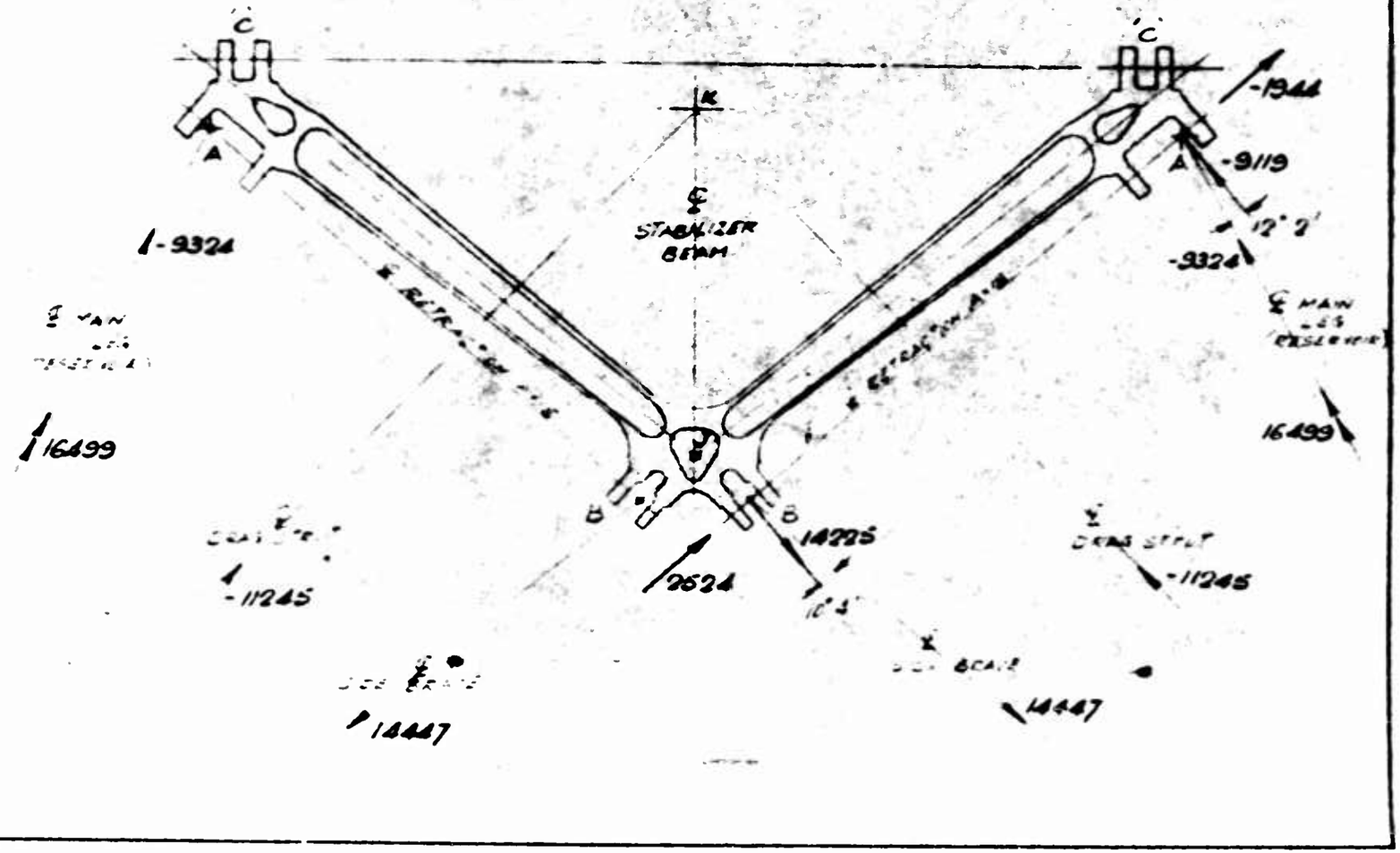
MAIN GEAR

VEE STRUT

H W LOUD MACHINE WORKS, INC.
887 EAST SECOND ST POMONA CALIFORNIA

PAGE 142

CONDITION: 10

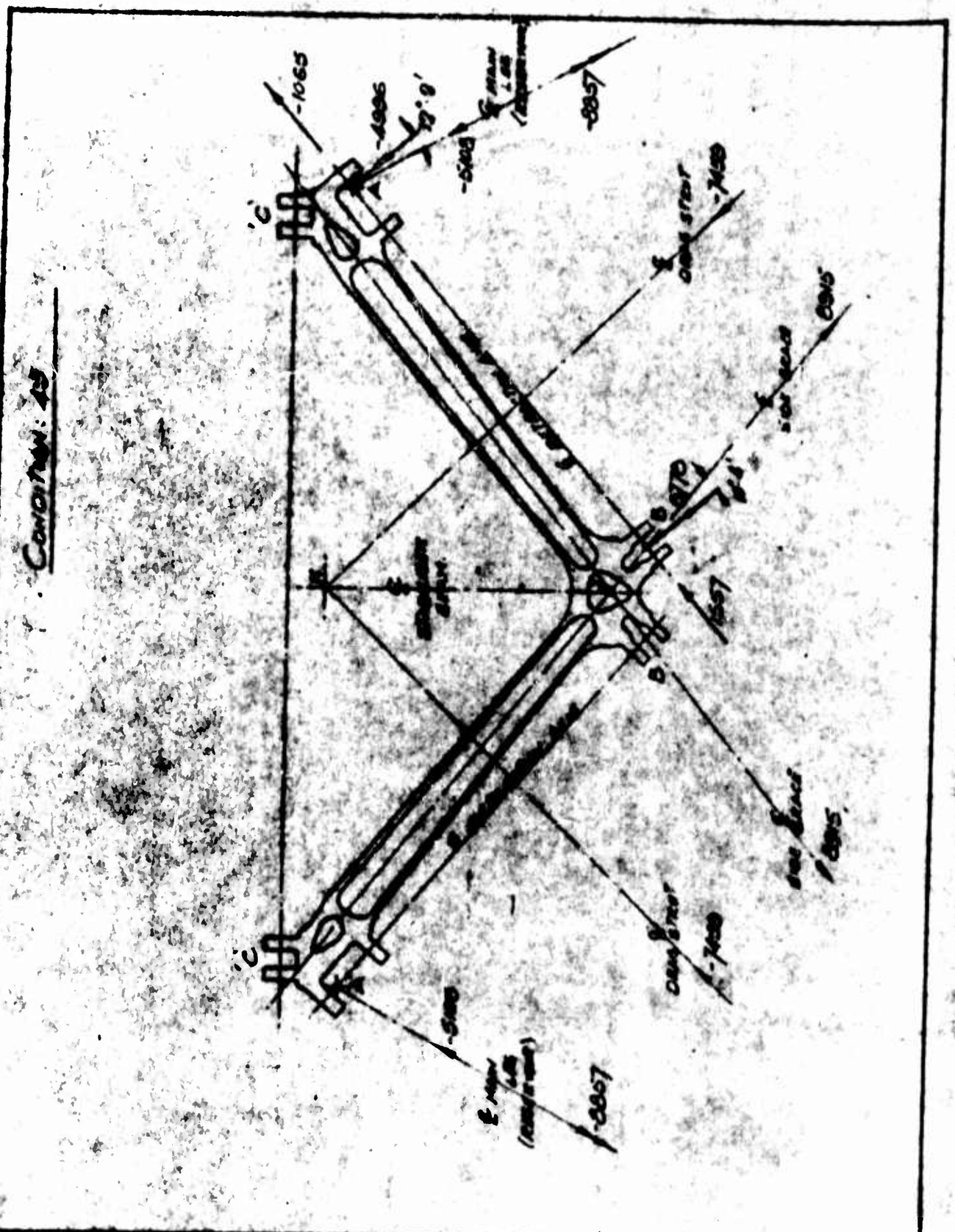


	CALC	CHECK	APP	APP

	REVISED	DATE

H. W. LOUD MACHINE WORKS INC
887 EAST SECOND ST POMONA CALIFORNIA

PAGE 143



CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15IC L
CHECK						RYAN
APP					H W LOUD MACHINE WORKS, INC 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 144
DPR						

BASIC LOADS

COS 12° 02' = .9780 COS 10° 04' = .9846
SIN 12° 02' = .2085 SIN 10° 04' = .1747

CONDITION 1

@ A -11504 (.9780) = -11251 LBS
-11504 (.2085) = -2399 LBS

@ B 17104 (.9846) = 16841 LBS
17104 (.1747) = 2988 LBS

CONDITION 6

@ A -39117 (.9780) = -38256 LBS
-39117 (.2085) = -8156 LBS

@ B -369 (.9846) = -363 LBS
-369 (.1747) = -64 LBS

CONDITION 10

@ A -4111 (.9780) = -4021 LBS
-4111 (.2085) = -857 LBS

@ B -7804 (.9846) = -7684 LBS
-7804 (.1747) = -1363 LBS

CONDITION 38

@ A -19022 (.9780) = -18604 LBS
-19022 (.2085) = -3966 LBS

@ B 19298 (.9846) = 19001 LBS
19298 (.1747) = 3371 LBS

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						
APP						RYAN
APP					H. W. LOUD MACHINE WORKS, INC 867 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 145

BASIC LOADS CONT.

CONDITION 40

@ A
-9324 (.9780) = -9119 LBS
-9324 (.2085) = -1944 LBS

@ B
14447 (.9846) = 14225 LBS
14447 (.1747) = 2524 LBS

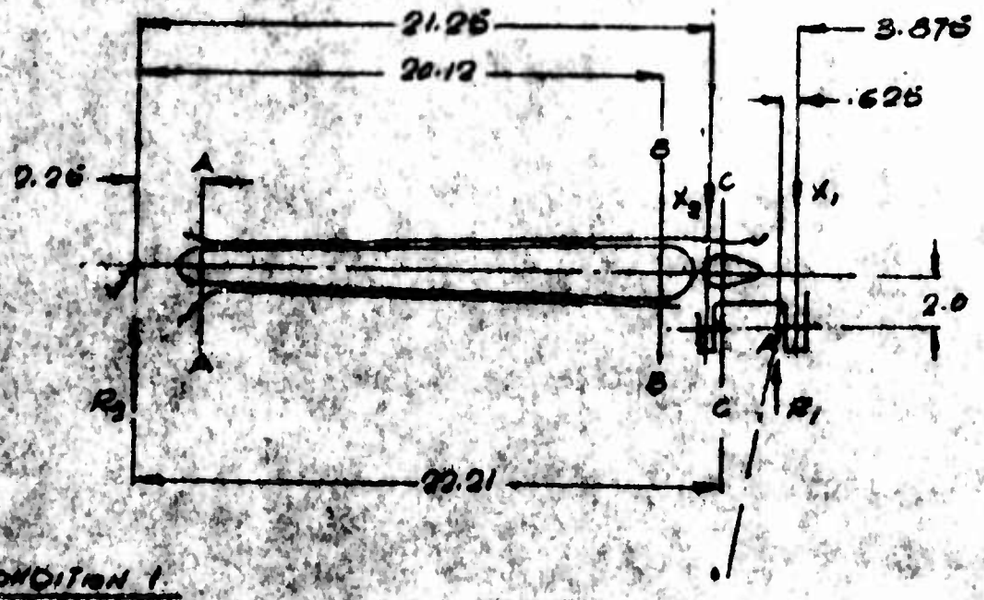
CONDITION 45

@ A
-5108 (.9780) = -4996 LBS
-5108 (.2085) = -1065 LBS.

@ B
8915 (.9846) = 8778 LBS
8915 (.1747) = 1557 LBS

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15101
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 146

VEE BRACE LOADING



CONDITION 1.

MAX LOAD AT J FROM TORQUE IN MAIN LEG

$= {}^{4281}/_{2450} \times 2 = 350$ LBS

$X_2 = {}^{.625}/_{3.875} \times 11251 = 1815$ LBS

$X_1 = {}^{3.25}/_{3.875} \times 11251 = 9436$ LBS.

$R_1 = \dfrac{25.125 \times 9436 + 2.125 \times 1815}{25.125} = 10371$ LBS.

$R_2 = \dfrac{3.875 \times 1815}{25.125} = 280$ LBS

TRANSVERSE LOAD FROM 4281 IN LB TORQUE $= {}^{4281}/_{3.875} = 1105$ LBS

TORQUE $= 1105 \times 2.0 = 2210$ IN. LBS.

ASSUMING SIDE BRACE LOAD IS AXIAL

TENSION = 17104 LBS.

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					VEE BRACE	RYAN
APP						
APP					H. W. LOUD MACHINE WORKS, INC. 987 EAST BECKING ST., PEMONA, CALIFORNIA	PAGE 147

VEE BRACE LOADING - CONT

CONDITION 6.

MAX. LOAD AT J FROM TORQUE IN MAIN LEG

$= 8768/24.66 \times 2 = 716$ LBS

$X_2 = 625/3.875 \times 38256 = 6170$ LBS

$X_1 = 3.25/3.875 \times 38256 = 32086$ LBS

$R_1 = \frac{25.125 \times 32086 + 21.25 \times 6170}{25.125} = 37504$ LBS

$R_2 = \frac{3.875 \times 6170}{25.125} = 952$ LBS

TRANSVERSE LOAD FROM 8768 IN. LBS TORQUE = $8768/3.876 = 2263$ LBS

TORQUE = $2263 \times 2.0 = 4526$ IN. LBS

COMPRESSION = 368 LBS.

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15101
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 148
APR						

VEE BRACE LOADING - CONT

CONDITION 10

MAX. LOAD AT J FROM TORQUE IN MAIN LEG

$= 8222/24.50 \times 2 = 671$ LBS

$X_2 = .625/3.875 \times 4021 = 649$ LBS

$X_1 = 3.25/3.875 \times 4021 = 3372$ LBS

$R_1 = \frac{25.125 \times 3372 + 21.25 \times 649}{25.125} = 3921$ LBS

$R_2 = \frac{3.875 \times 649}{25.125} = 100$ LBS

TRANSVERSE LOAD FROM 8222 IN. LBS TORQUE. $8222/3.875 = 2122$ LBS

TORQUE $= 2122 \times 2.0 = 4244$ IN LBS

COMPRESSION $= 7804$ LBS

CALC			REVISED	DATE	MAIN GEAR	15'CL
CHECK					VEE BRACE	
APP						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 149

VEE BRACE LOADING CONT

CONDITION 3B

MAX. LOAD AT J FROM TORQUE IN MAIN LEG

$= 3754/24.50 = 153$ IN LBS

$X_2 = .525/3.875 \times 18604 = 3001$ LBS

$X_1 = 3.25/3.875 \times 18604 = 15603$ LBS

$R_1 = \frac{25.125 \times 15603 + 21.25 \times 3001}{25.125} = 18141$ LBS

$R_2 = \frac{3.875 \times 3001}{25.125} = 463$ LBS

TRANSVERSE LOAD FROM 3754 IN LBS TORQUE $= 3754/3.875 = 969$ LBS

TORQUE $= 969 \times 20 = 1938$ IN LBS

TENSION = 19298 LBS

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					VEE BRACE	RYAN
APR					H. W. LOUD MACHINE WORKS, INC	PAGE
APR					887 EAST SECOND ST., POMONA, CALIFORNIA	150

VEE BRACE LOADING - CONT

CONDITION 40

MAX LOAD AT J FROM TORQUE IN MAIN LEG

$= 16499/24.50 \times 2 = 1347$ LBS

$X_2 = .625/3.875 \times 9119 = 1471$ LBS

$X_1 = 3.25/3.875 \times 9119 = 7648$ LBS

$R_1 = \dfrac{25.125 \times 7648 + 21.25 \times 1471}{25.125} = 8892$ LBS

$R_2 = \dfrac{3.875 \times 1471}{25.125} = 227$ LBS

TRANSVERSE LOAD FROM 16499 IN LBS TORQUE : $16499/3.875 = 4258$ LBS

TORQUE = $4258 \times 20 = 8516$ IN LBS

TENSION = 14447 LBS.

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					VEE BRACE	
APR						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 151

VEE BRACE LOADING - CONT

CONDITION 45.

MAX. LOAD AT J FROM TORQUE IN MAIN LEG

$= 8857/24.50 \times 2 = 724$ LBS

$X_2 = .625/3.875 \times 4996 = 806$ LBS.

$X_1 = 3.25/3.875 \times 4996 = 4190$ LBS.

$R_1 = \frac{25.125 \times 4190 + 21.25 \times 806}{25.125} = 4572$ LBS.

$R_2 = \frac{3.875 \times 806}{25.125} = 124$ LBS.

TRANSVERSE LOAD FROM 8857 IN. LBS TORQUE $= 8857/3.875 = 2286$ LBS.

TORQUE $= 2286 \times 2.0 = 4572$ IN. LBS.

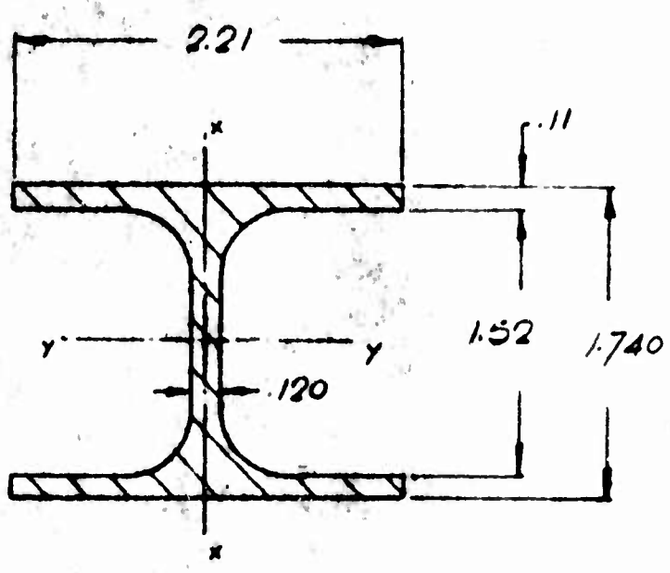
TENSION $= 8915$ LBS

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN.
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 152

SECTION A-A (2.25 ABOVE J)

MAT'L ALUM ALLOY 7079-T6

CONDITION 3B CRITICAL



AREA = 2.21 × 1.740 − 1.52(2.21 − .120)

= 3.846 − 3.177 = .668 IN.²

$$I_{xx} = \frac{2 \times .11 \times 2.21^3 + 1.52 \times .120^3}{12} = .198 \text{ IN}^4$$

$$I_{yy} = \frac{2.21 \times 1.740^3 - 1.52^3(2.21 - .120)}{12} = .359 \text{ IN}^4$$

M_{x-x} @ A-A = 153 × 2.25/2 = 172 IN LBS

M_{yy} @ A-A = 463 × 2.25 = 1042 IN. LBS.

K = 1.50

F_{bu} = 71000 × 1.50 = 106500 psi

F_{tu} = 71000 psi

F_{su} = 43000 psi

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					VEE BRACE	RYAN
APP					N. W. LOUD MACHINE WORKS, INC	PAGE
APP					887 EAST SECOND ST., POMONA, CALIFORNIA	153

SECTION A A CONT

$f_{b\,x\text{-}x} = \frac{172 \times 1.105 \times 1.50}{.198} = 1444$ psi $R_{b\,x\text{-}x} = \frac{1444}{106500} = .014$

$f_{by\text{-}y} = \frac{1042 \times .870 \times 1.50}{.359} = 3788$ psi $R_{by\text{-}y} = \frac{3788}{106500} = .036$

$f_{b} = \frac{19298 \times 1.50}{.668} = 43334$ psi $R_{b} = \frac{43334}{71000} = .610$

$f_{s\,x\text{-}x} = \frac{153 \times 1.50}{2 \times .668} = 172$ psi $R_{s\,x\text{-}x} = \frac{172}{43000} = .004$

$f_{s\,y\text{-}y} = \frac{463 \times 1.50}{.668} = 1040$ psi $R_{s\,y\text{-}y} = \frac{1040}{43000} = .024$

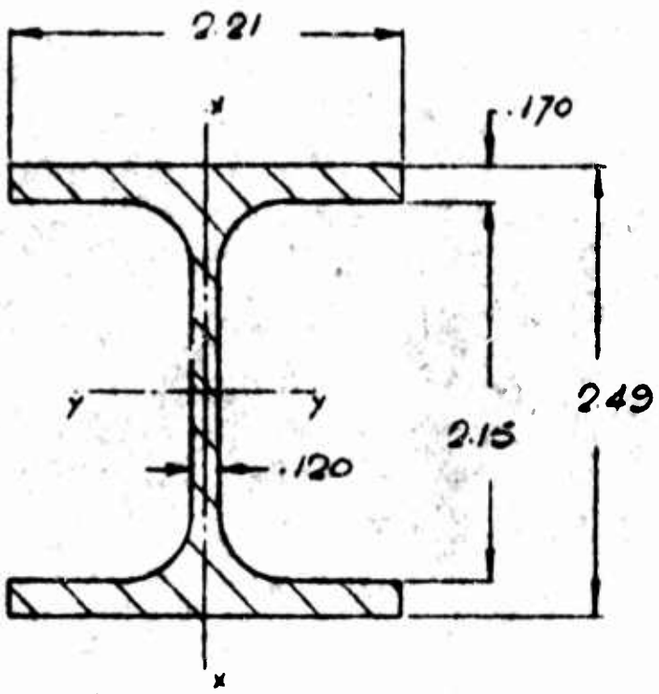
$$MS_{ULT} = \frac{1}{[.610 + (.014 + .036)] + (.004 + .024)} - 1$$

$$= \frac{1}{.6495} - 1 = +.54$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 807 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 154

SECTION B-B (20.12 ABOVE J)

CONDITION 40 CRITICAL



AREA = 2.21 × 2.49 - 2.15(2.21-.12) = 5.503 - 4.494 = 1.009 IN²

$I_{x-x} = \frac{2 \times .17 \times 2.21^3 + 2.15 \times .12^3}{12} = .306$ IN⁴

$I_{y-y} = \frac{2.21 \times 2.49^3 - 2.15^3(2.21-.12)}{12} = 1.113$ IN⁴

K = 1.50

$F_{bu} = 71000 \times 1.50 = 106500$ psi

$F_{tu} = 71000$ psi

$F_{su} = 43000$ psi

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 155
APP						

SECTION B B CONT

M_{x-x} @ B-B = 1347 × 20.12/2 = 13551 IN LBS

M_{y-y} @ B-B = 227 × 20.12 = 4567 IN LBS

$f_{b_{v-v}} = \frac{13551 \times 1.105 \times 1.50}{.306} = 73401$ psi $\quad R_{b_{v-v}} = \frac{73401}{106500} = .689$

$f_{b_{y-y}} = \frac{4567 \times 1.245 \times 1.50}{1.113} = 7668$ psi $\quad R_{b_{y-y}} = \frac{7668}{106500} = .072$

$f_{t_c} = \frac{14447 \times 1.50}{1.009} = 21477$ psi $\quad R_{t_c} = \frac{21477}{71000} = .302$

$f_{s_{x-y}} = \frac{1347 \times 1.50}{2 \times 1.009} = 1001$ psi $\quad R_{s_{x-y}} = \frac{1001}{43000} = .023$

$f_{s_{y-y}} = \frac{227 \times 1.50}{1.009} = 334$ psi $\quad R_{s_{y-y}} = \frac{334}{43000} = .008$

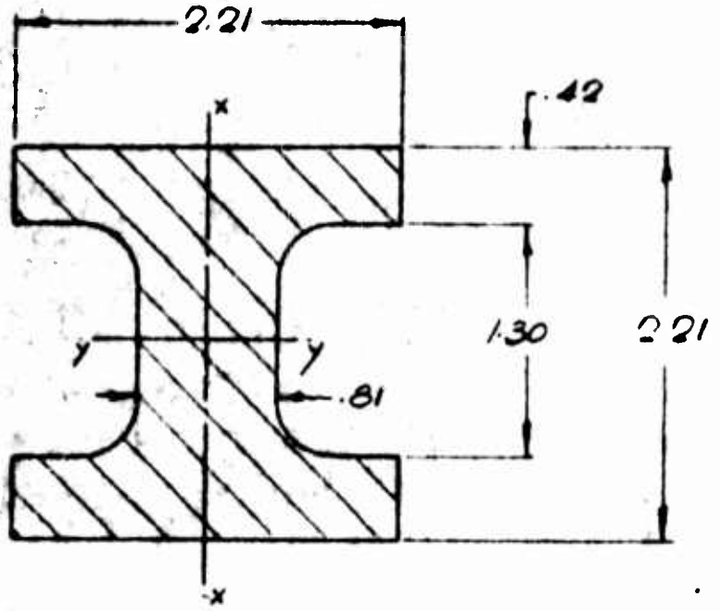
$$MS_{ult} = \frac{1}{[.302 + (.689 + .072)] + (.023 + .008)} - 1$$

$$= \frac{1}{.995} - 1 = .005$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 136
APR						

SECTION C-C (22.21 ABOVE J)

CONDITION 40 CRITICAL



AREA = 2.21 × 2.21 - 1.30 (2.21 - .81)

= 4.884 - 1.820 = 3.064 IN.²

$I_{x\text{-}y} = \frac{(2.21 - 1.30) \times 2.21^3 + 1.30 \times .81^3}{12} = .761$ IN.⁴

$I_{y\text{-}y} = \frac{2.21 \times 2.21^3 - 1.30^3 (2.21 - .81)}{12} = 1.731$ IN.⁴

K = 1.50

F_{bu} = 71000 × 1.50 = 106500 psi

F_{tu} = 71000 psi

F_{su} = 43000 psi

CALC	[illegible]		REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 157
APR						

SECTION C C CONT

M_{x-x} @ C C = 1347 × 22.21/2 = 14958 IN LBS

M_{y-y} @ C-C = 227 × 22.21 = 5042 IN LBS

$f_{b_{x-x}} = \frac{14958 \times 1.105 \times 1.50}{.761} = 32579$ psi $\qquad R_{x-x} = \frac{32579}{106500} = .306$

$f_{b_{y-y}} = \frac{5042 \times 1.105 \times 1.50}{1.731} = 4828$ psi $\qquad R_{y-y} = \frac{4828}{106500} = .045$

$f_t = \frac{14447 \times 1.50}{3.064} = 7073$ psi $\qquad R_t = \frac{7073}{71000} = .100$

$f_s = \frac{8516 \times .21 \times 1.50}{\frac{1}{3}[(2.21 \times .42^3) + (2.21 \times .42^3) + (1.30 \times .81^3)]} = 30486$ psi $\qquad R_{s_u} = \frac{30486}{43000} = .709$

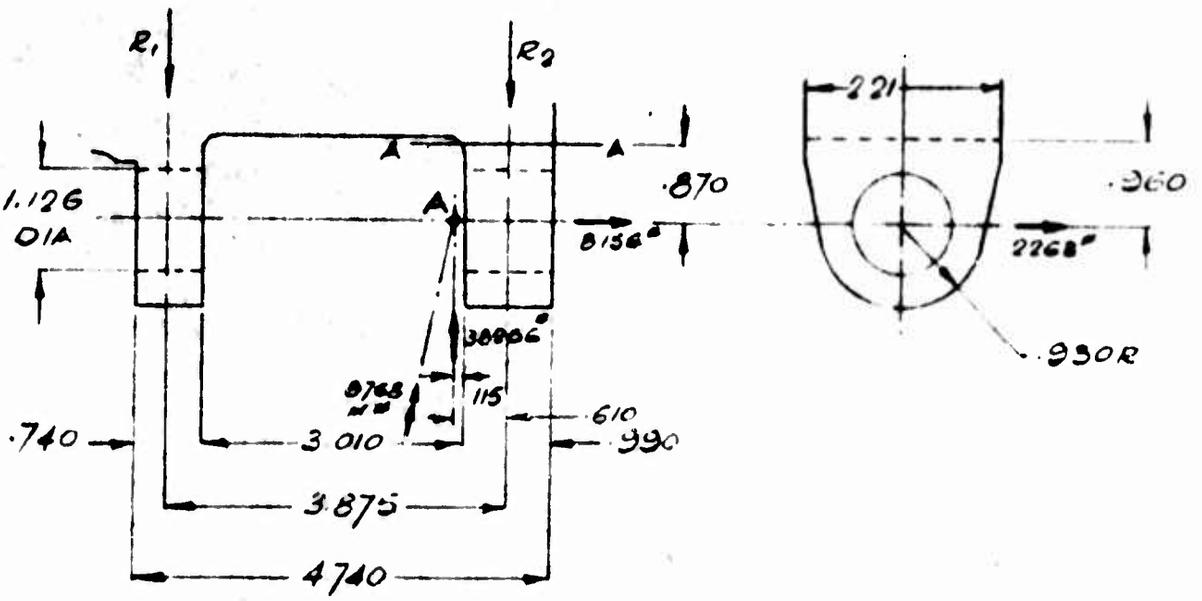
$$MS_{ult} = \frac{1}{[(1.306 + .045) + (.100)] + .709} - 1$$

$$= \underline{+.22}$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						
APR						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 158

UNIVERSAL JOINT ATTACHMT LUG AT A

CONDITION 6 CRITICAL



$R_1 = .610/3.875 \times 38256 = 6022$ LBS

$R_2 = 3.265/3.875 \times 38256 = 32234$ LBS

SECTION A-A

$M_{x-x} = 8156 \times .870 = 7076$ IN LBS

$M_{y-y} = 2263 \times .870 = 1969$ IN LBS

$I_{x-x} = \frac{2.21 \times .99^3}{12} = .1787$ IN.^{4}

$I_{y-y} = \frac{.99 \times 2.21^3}{12} = .8902$ IN.^{4}

AREA $= 2.21 \times .99 = 2.188$ IN.^{2}

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					VEE BRACE	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 139

ATTACH MT LUG AT A CONT

SECTION A-A CONT.

$F_{bu} = 71000 \times 1.50 = 106500$ psi

$F_c = 65000$ psi

$F_{su} = 43000$ psi

$f_{bx-x} = \frac{7076 \times .495 \times 1.50}{.1787} = 29401$ psi $\quad R_{bx-x} = \frac{29401}{106500} = .276$

$f_{by-y} = \frac{1969 \times 1.105 \times 1.50}{.8902} = 3666$ psi $\quad R_{by-y} = \frac{3666}{106500} = .034$

$f_{cy} = \frac{32251 \times 1.50}{2.188} = 22038$ psi $\quad R_c = \frac{22038}{65000} = .340$

$f_{sx-x} = \frac{8156 \times 1.50}{2.188} = 5591$ psi $\quad R_{sx-x} = \frac{5591}{43000} = .130$

$f_{sy-y} = \frac{2263 \times 1.50}{2.188} = 1551$ psi $\quad R_{sy-y} = \frac{1551}{43000} = .036$

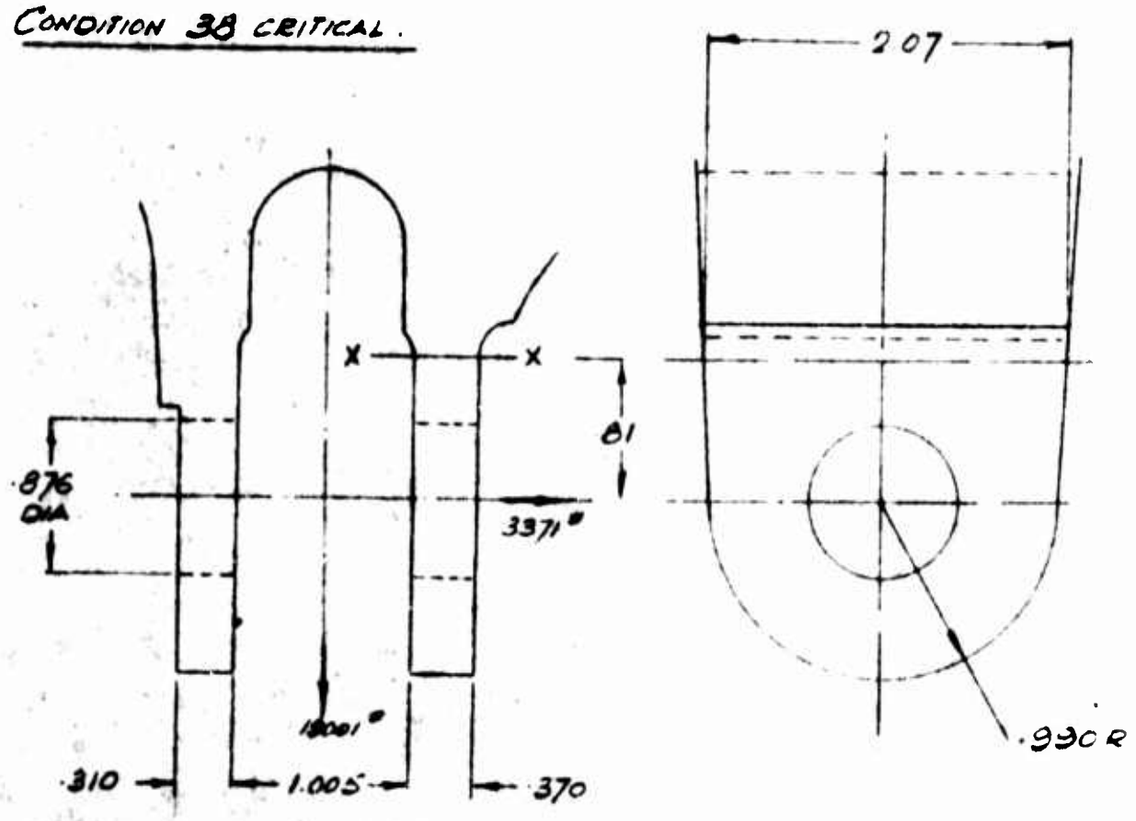
$$MS_{ULT} = \frac{1}{.340 + [(.276 + .034)^2 + (.130 + .036)^2]^{\frac{1}{2}} - 1}$$

$$= +.45$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15101
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 160
APP						

SIDE BRACE ATTACH MT LUG AT B

CONDITION 3B CRITICAL.



SECTION X-X

ASSUMING AN 80/20 LOAD DISTRIBUTION

$M = 3371 \times .81 \times .80 = 2184$ IN. LBS

AREA $= .370 \times 2.07 = .7659$ IN.^{2}

$I = \frac{2.07 \times .370^3}{12}$, $.0087$ IN.^{4}

$K = 1.50$

$F_{bu} = 71/74 \times 105000 = 100743$ psi

$F_{tu} = 71000$ psi

$F_{su} = 43000$ psi

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1010L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 161
APR						

SIDE BRACE ATTACH^{MT} LUG AT 'B'

SECTION X-X CONT

$f_{bu} = \frac{2184 \times 1.50 \times .185}{.0087} = 69662 \text{ psi}$ $\quad R_{bu} = \frac{69662}{100743} = .691$

$f_{tu} = \frac{19001 \times 1.50}{2 \times 7659} = 18607 \text{ psi}$ $\quad R_{tu} = \frac{18607}{71000} = .262$

$f_{su} = \frac{3371 \times 1.50}{7659} = 6602 \text{ psi}$ $\quad R_{su} = \frac{6602}{43000} = .154$

$$MS_{ULT} = \frac{1}{(.691 + .262) + .154} - 1 = \underline{+.04}$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15101
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 162

SIDE BRACE ATTACH MT LUG AT B CONT

TENSION

$$P'_{tu} = K_t F_{tu} A_t,$$

W = .990 × 2 + 1.980

D = .876

T = .310

$$W/D = 1.980/.876 = 2.26 \qquad K_t = .95$$

$$A_t = (1.980 - .876) \times .310 = .3422$$

$$P'_{tu} = .95 \times 71000 \times .3422 = 23081 \text{ LBS}$$

$$MS_{ULT} = \frac{23081 \times 2}{19001 \times 1.50 \times 1.15} - 1 = \underline{+.41}$$

FITTING FACTOR

SHEAR-BEARING

$$P'_{bru} = K_{br} F_{tu} A_{br}$$

a = .990

D = .876

T = .310

$$a/D = .990/.876 = 1.13 \qquad K_{br} = .96$$

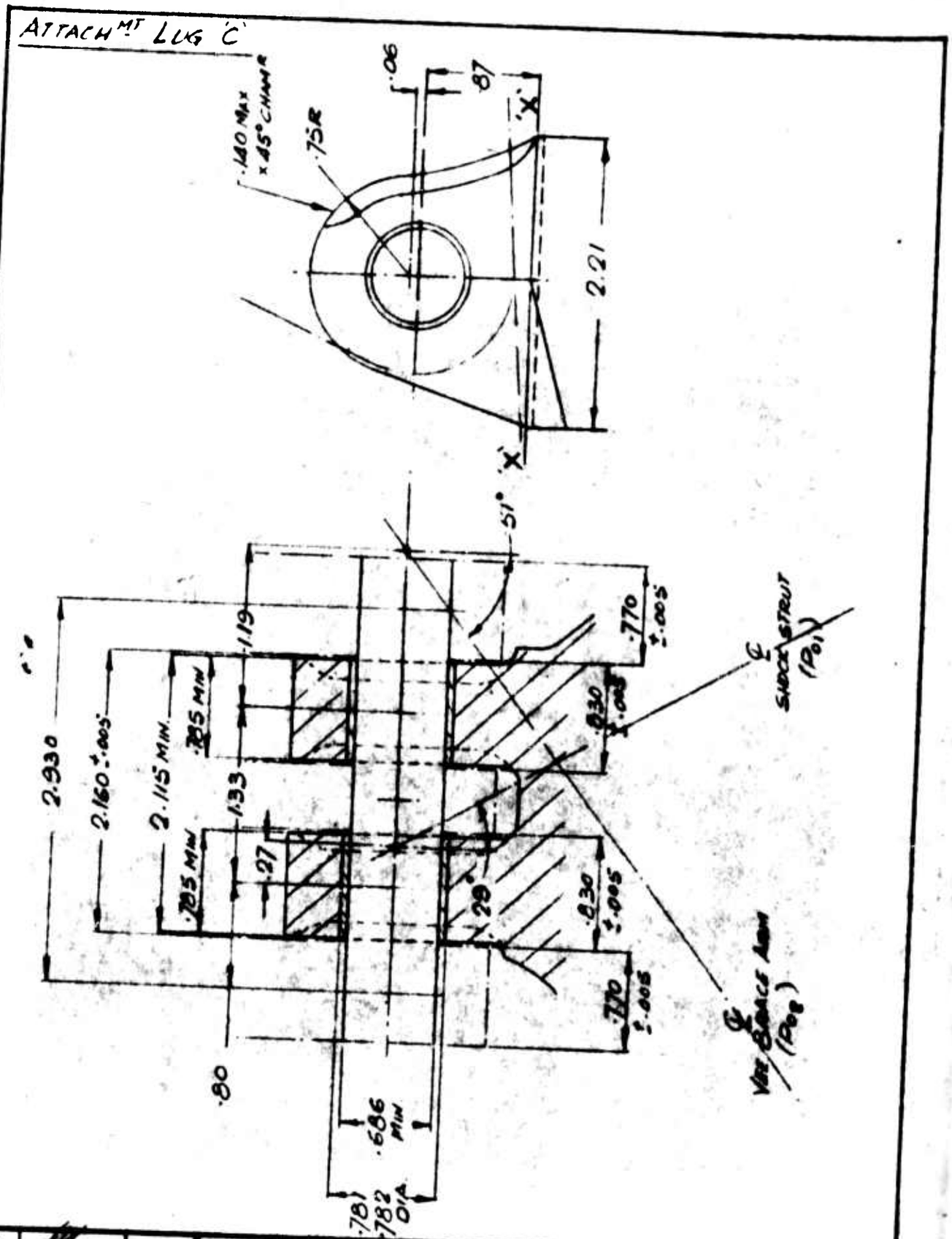
$$A_{br} = .876 \times .310 = .2716$$

$$P'_{bru} = .96 \times 71000 \times .2716 = 18512 \text{ LBS}$$

$$MS_{ULT} = \frac{18512 \times 2}{19001 \times 1.50 \times 1.15} - 1 = \underline{+.13}$$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						
APR						RYAN
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 163



CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 164
APR						

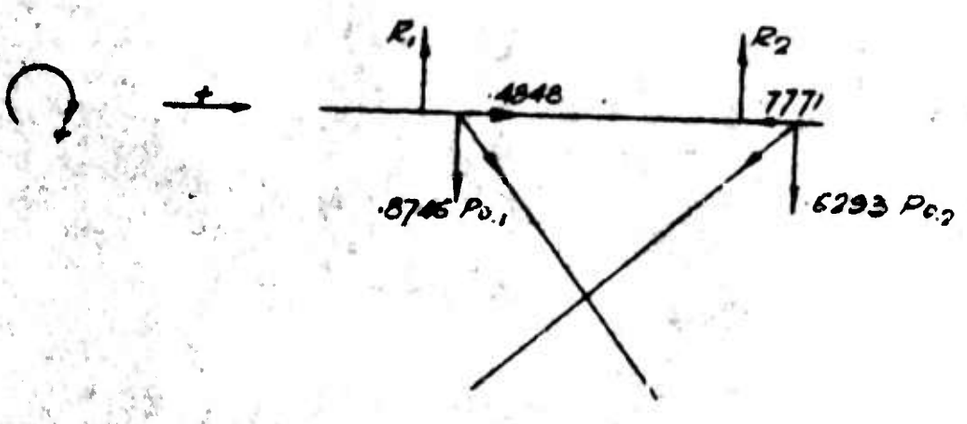
ATTACH MT LUG 'C' - LOADING

COS 51° (P_{o_3}) = .6293 P_{o_3}

SIN 51° (P_{o_3}) = .7771 P_{o_3}

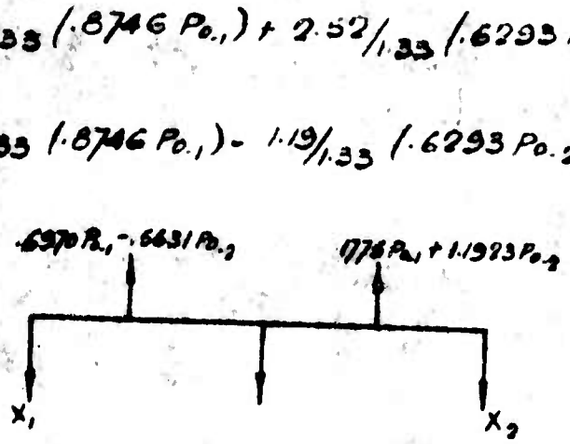
COS 28° (P_{o_1}) = .8746 P_{o_1}

SIN 28° (P_{o_1}) = .4848 P_{o_1}



$R_2 = .27/1.33 (.8746\ P_{o.1}) + 2.52/1.33 (.6293\ P_{o.2}) = .1775\ P_{o.1} + 1.1923\ P_{o.2}$

$R_1 = 1.06/1.33 (.8746\ P_{o.1}) - 1.19/1.33 (.6293\ P_{o.2}) = .6970\ P_{o.1} - .5631\ P_{o.2}$



$X_2 = .80/2.93 (.6970\ P_{o.1} - .5631\ P_{o.2}) + 2.13/2.93 (.1775\ P_{o.1} + 1.1923\ P_{o.2})$

$X_1 = 2.13/2.93 (.6970\ P_{o.1} - .5631\ P_{o.2}) + .80/2.93 (.1775\ P_{o.1} + 1.1923\ P_{o.2})$

$X_2 = .190\ P_{o.1} - .154\ P_{o.2} + .129\ P_{o.1} + .867\ P_{o.2} = .319\ P_{o.1} + .713\ P_{o.2}$

$X_1 = .507\ P_{o.1} - .409\ P_{o.2} + .048\ P_{o.1} + .325\ P_{o.2} = .555\ P_{o.1} - .084\ P_{o.2}$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510 L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 165
APP						

ATTACH MT LEG C - LOADING CONT

CONDITION 2

$R_2 = .1775(-14866) + .1923(18950) = 19355$ LBS

$R_1 = .6970(-14866) - .5631(18950) = -21033$ LBS

$X_2 = .319(-14866) + .713(18950) = 8769$ LBS

$X_1 = .555(-14866) + .084(18950) = -9843$ LBS

CONDITION 6

$R_2 = .1775(-33117) + .1923(-369) = -7383$ LBS

$R_1 = .6970(-33117) - .5631(-369) = -22057$ LBS

$X_2 = .319(-33117) + .713(-369) = -12741$ LBS

$X_1 = .555(-33117) + .084(-369) = -21679$ LBS

LATERAL LOAD (COND 2) $= .4848 P_{0.1} - .7771 P_{0.2}$

$= .4848(-14866) - .7771(18950) = -21933$ LBS

LATERAL LOAD (COND 6)

$= .4848(-33117) - .7771(-369) = -18677$ LBS

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	151CL
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 166

OUTER ATTACH^{MT} LUG AT C

CONDITION 2 CRITICAL

TENSION

R_2 = 19955 LBS LIMIT

$P'_{tu} = K_t F_{tu} A_t$

W = 1.50

D = .782

T = .785

$W/D = 1.50/.782 = 1.92$ ∴ $K_t = .970$

$A_t = (1.50 - .782) \times .785 = .564$

$F_{tu} = 71000$ psi

$P'_{tu} = .970 \times 71000 \times .564 = 38843$ LBS

$MS_{ULT} = \frac{38843}{19955 \times 1.50 \times 1.15} - 1 = \underline{+.13}$

FITTING FACTOR

SHEAR-BEARING

$P'_{bru} = K_{br} F_{tu} A_{br}$

a = .75 + .06 = .81

D = .782

T = .785

$a/D = .81/.782 = 1.04$ ∴ $K_{br} = .88$

$A_{br} = .782 \times .785 = .614$

$P'_{bru} = .88 \times 71000 \times .614 = 38363$ LBS

$MS_{ULT} = \frac{38363}{19955 \times 1.50 \times 1.15} - 1 = \underline{+.11}$

FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS INC. 667 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 167

ATTACHMT LUG C CONT

SECTION X-X CONDITION 2 CRITICAL

ASSUMING A 50/50 LOAD DISTRIBUTION ON LUGS

LATERAL LOAD = 21933 LBS 50% = 10967 LBS.

$M = 10967 \times .87 = 9541$ IN. LBS.

$I = \frac{2.21 \times .785^3}{12} = .0891$ IN.^{4}

$A = 2.21 \times .785 = 1.735$ IN.^{2} $K = 1.50$

$F_{bu} = 71/74 \times 105000 = 100748$ psi

$F_{cy} = 65000$ psi

$F_{su} = 43000$ psi

$f_{bu} = \frac{9541 \times 1.50 \times 3925}{.0891} = 63044$ psi $R_{bu} = \frac{63044}{100748} = .626$

$f_{cy} = \frac{21033 \times 1.50}{1.735} = 18184$ psi $R_{cy} = \frac{18184}{65000} = .280$

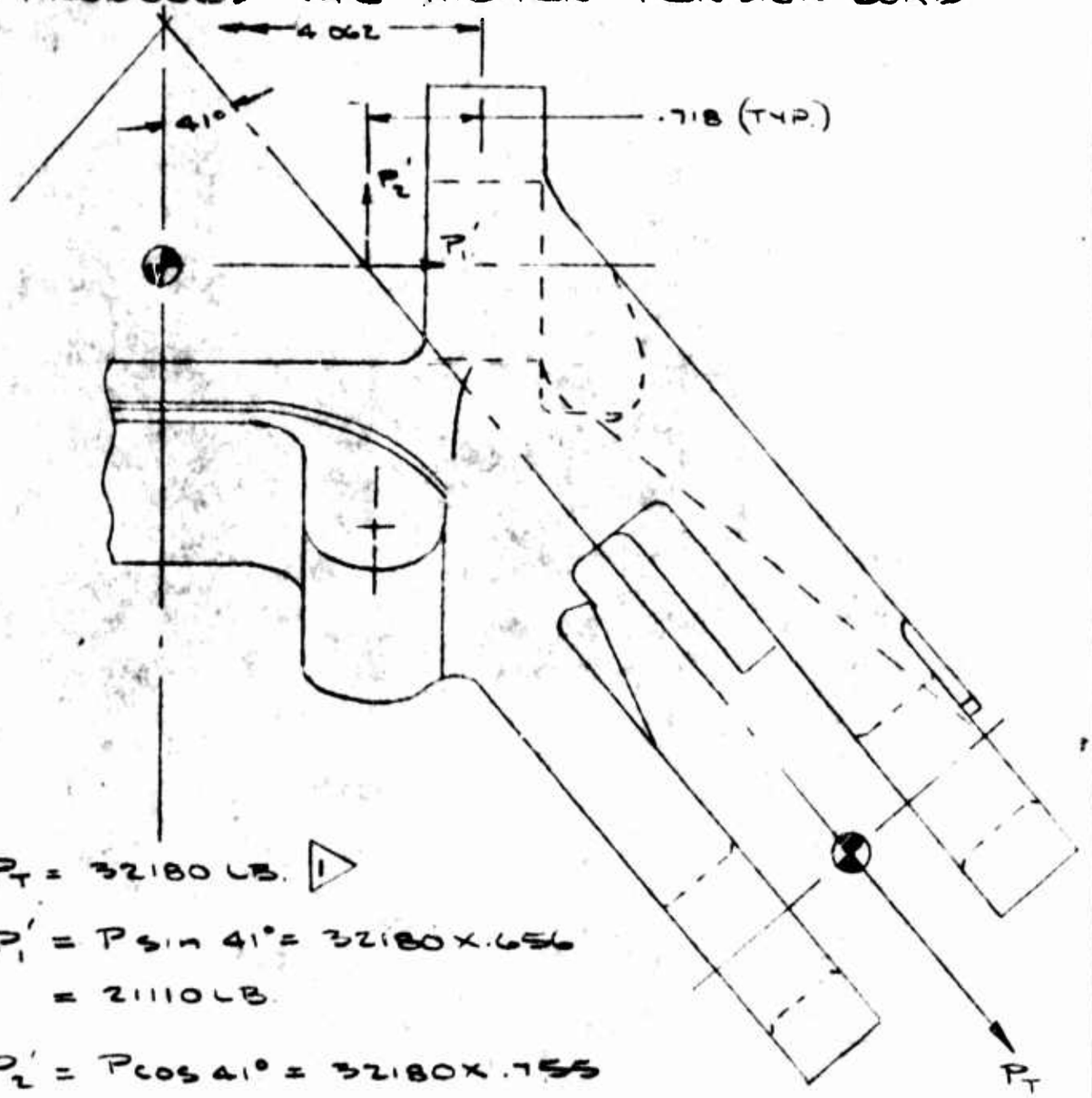
$f_{su} = \frac{10967 \times 1.50}{1.735} = 9482$ psi $R_{su} = \frac{9482}{43000} = .221$

$$MS_{ULT} = \frac{1}{.280 + (1.626 + .221)} - 1 = \underline{+.06}$$

CALC			REVISED	DATE	MAIN GEAR VEE BRACE	15106
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC. 827 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 168
APR						

FITTING - CLUSTER 1510L403

LUG ANALYSIS CONDITION 6 CRITICAL LOAD IN TENSION WILL BE CONSIDERED TAKEN FROM BOTH LUG ENDS WHICH PRODUCES THE HIGHER TENSION LOAD



P_T = 32180 LB. ▷1

$P_1' = P \sin 41° = 32180 \times .656$

= 21110 LB.

$P_2' = P \cos 41° = 32180 \times .755$

= 24300 LB.

▷1 REF. P. 90

CALC	Rohlich		REVISED	DATE	MAIN GEAR	1510L
CHECK					FITTING - CLUSTER	RYAN
APR						
APR					H W LOUD MACHINE WORKS INC	PAGE
					887 EAST SECOND ST POMONA CALIFORNIA	169

FITTING - CLUSTER

7079 T6 ALUM. AL
HAND FORGING

LUG ANALYSIS

$a = .930$
$D = 1.001$
$W = 1.860$
$t = .608$
$W/D = 1.86$

$a/D = .93$
$A_{br} = Dt = .608$
$A_t = (W-D)t = .522$
$K_t = .975$
$K_{br} = .74$

$P_T = 32180$ LB. [1] $P/LUG = 16090$ LB.

TENSION

$P'_{tu} = K_t F_{tu} A_t = .975 \times 71000 \times .522 = 36135$ LB. [2]

$$M.S. = \frac{36135}{1.15 \times 16090 \times 1.5} - 1 = .30$$ [3]

SHEAR BEARING

$P_{bru} = K_{br} F_{tuk} A_{br} = .74 \times 67000 \times .608 = 30140$ LB. [2]

$$M.S. = \frac{30140}{1.15 \times 16090 \times 1.5} - 1 = .09$$ [3]

LUG YIELD

$$\frac{P'_{u(MIN)}}{A_{br} F_{tu}} = \frac{30140}{.608 \times 71000} = .698 \quad \therefore C = 1.1$$

$$P'_y = C \left(\frac{F_{ty}}{F_{tu}}\right) P'_{u(MIN)} = 1.1 \left(\frac{62}{71}\right) 30140 = 28930 \text{ LB}$$

$$\text{YIELD M.S.} = \frac{1.5 \times 28930}{1.15 \times 16090} - 1 = 1.34$$ [4]

[2] REF. 2 P. 121
[1] REF. P. 90
[3] FITTING FACTOR

CALC	[illegible]		REVISED	DATE	MAIN GEAR FITTING - CLUSTER	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., PERONA, CALIFORNIA	PAGE 170

FITTING - CLUSTER

LUG ANALYSIS - CONT.

$a = 1.125$
$D = 1.126$
$W = 2.250$
$t = .670$
$W/D = 2.0$
$a/D = 1.0$

$A_t = (W-D)t = .753$
$A_{br} = Dt = .754$
$K_t = .96$
$K_{br} = .84$

TENSION

$P'_{tu} = K_t F_{tu} A_t = .96 \times 71000 \times .753 = 51330$ LB.

$$M.S. = \frac{51330}{1.15 \times 24300 \times 1.5} - 1 = .22$$

SHEAR - BEARING

$P_{bru} = K_{br} F_{tu} A_{br} = .84 \times 67000 \times .754$
$= 42410$ LB.

$$M.S. = \frac{42410}{1.15 \times 24300 \times 1.5} - 1 = .01$$

LUG YIELD

$$\frac{P'_{u(min)}}{A_{br} F_{tu}} = \frac{42410}{.754 \times 71000} = .79 \quad \therefore C = 1.1$$

$$P'_y = C\left(\frac{F_{ty}}{F_{tu}}\right) P'_{u(min)} = 1.1\left(\frac{63}{71}\right) 42410 = 40710 \text{ LB.}$$

$$\text{YIELD M.S.} = \frac{1.5 \times 40710}{1.15 \times 24300} - 1 = 1.19$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					FITTING - CLUSTER	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 987 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 171

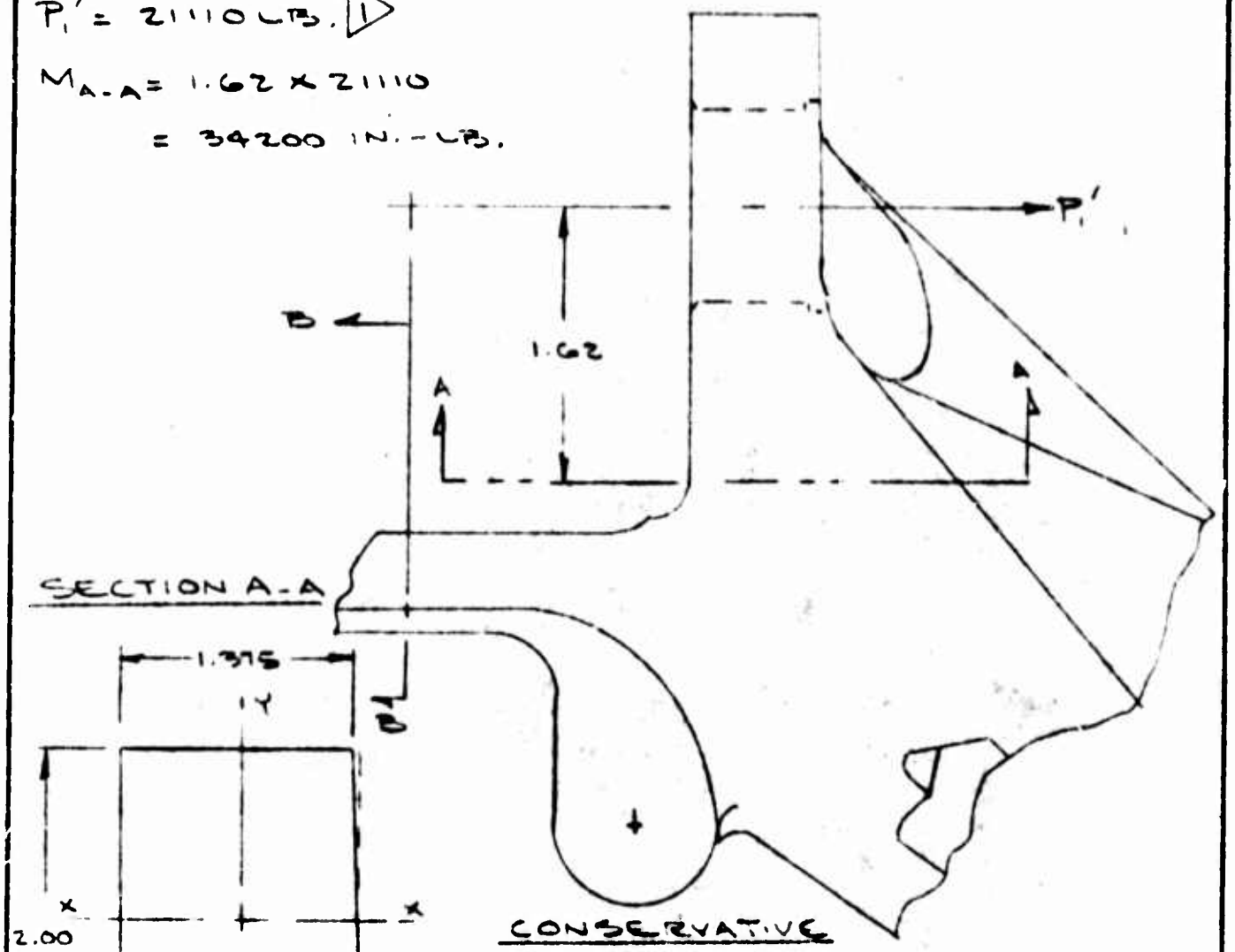
FITTING - CLUSTER

LUG ANALYSIS CONT.

$P_1' = 21110$ LBS. (1)

$M_{A-A} = 1.62 \times 21110$

$= 34200$ IN.-LBS.



SECTION A-A

CONSERVATIVE

$A = \frac{1.438 + 1.375}{2} \times 2.00 = 2.812$ IN.^{2}

$I_{Y-Y} = \frac{2 \times 1.406^3}{12} = .463$ IN.^{4}

$Q_{Y-Y} = .703 \times 2.00 \times .351 = .494$

$K_{Y-Y} = \frac{2 \times .494 \times .703}{.463} = 1.50$

$F_{bu_{Y-Y}} = \left(\frac{71}{74}\right) 105000 = 100695$ PSI

(1) REF. P. 169

CALC	[illegible]		REVISED	DATE	MAIN GEAR FITTING - CLUSTER	ISOL.
CHECK						
APR						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 172

FITTING - CLUSTER

LUG ANALYSIS CONT.

SECTION A-A CONT.

$$f_{bu} = \frac{34200 \times 1.5 \times .703}{.463} = 77900 \text{ PSI}$$

$$R_{bu} = \frac{77900}{100695} = .774$$

$$f_{tu} = \frac{24300 \times 1.5}{2.812} = 12950 \text{ PSI}$$

$$R_{t_u} = \frac{12950}{71000} = .182$$

$$M.S. = \frac{1}{.774 + .182} - 1 = .05$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					FITTING - CLUSTER	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 173

FITTING - CLUSTER

SECTION B3-B3

$P_T = P_1' = 21110$ LB. (1)

$A_t = .505 \times 1.166 = .589$ IN.^{2}

$$f_{tu} = \frac{21110 \times 1.5}{.589} = 53770$$

$$M.S. = \frac{71000}{53770} - 1 = \underline{.32}$$

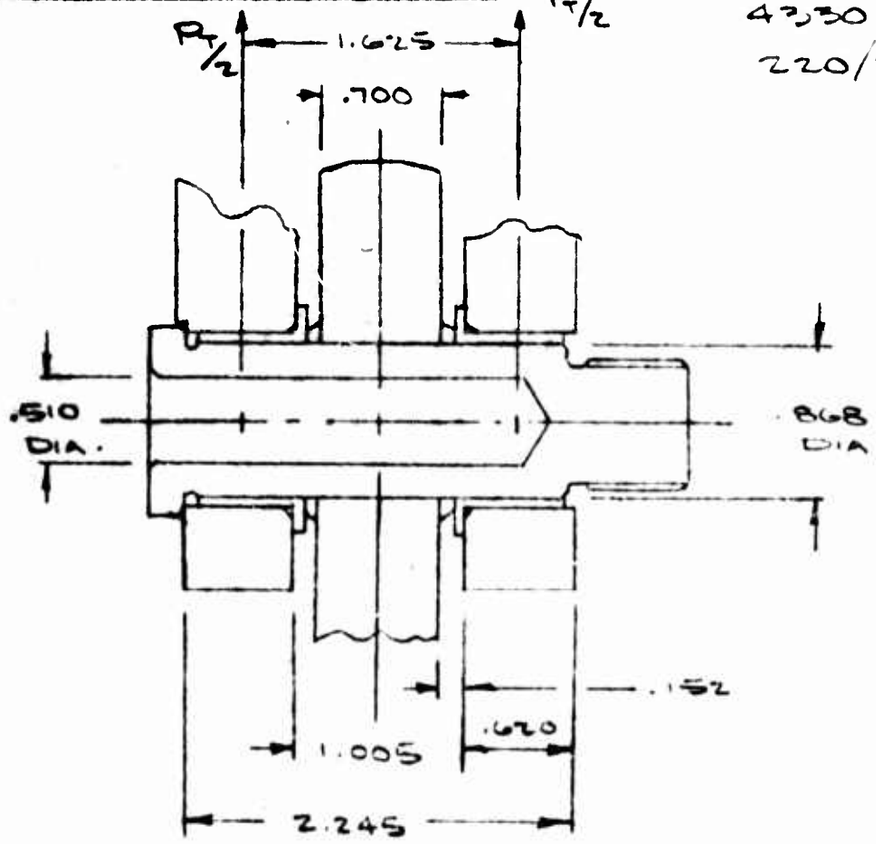
(1) REF. P. 169

CALC	Babit		REVISED	DATE	MAIN GEAR FITTING - CLUSTER	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 174
APR						

BOLT - UPPER DRAG BRACE ATTACH. (1510L404

CONDITION 6 CRITICAL

4330 MOD. STL
220/240 KSI



P_T = 32180 LB.

POINT OF MAX. BENDING

$M = (.620/2 + .700/4 + .152)(32180/2)$

$= (.637)(16090) = 10250$ IN-LB

O.D. =	.868	.591	.0275
I.D. =	.510	.204	.0033
2t =	.358	A = .387 IN.^{2}	I = .0242 IN.^{4}
t =	.179		
D/t =	4.85		

F_{bu} = 330000 PSI F_{su} = 125000 PSI

CALC	[illegible]		REVISED	DATE	MAIN GEAR BOLT	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 175

BOLT CONT

$$f_{bu} = \frac{10250 \times 1.5 \times .434}{.0242} = 275735 \text{ PSI}$$

$$R_{bu} = \frac{275735}{330000} = .836$$

$$M.S. = \frac{1}{.836} - 1 = \underline{.20}$$

AT SHEAR FACE

$$M = (.620/2 + .152)(32180/2) = 7430 \text{ IN.-LB}$$

$$P_s = 32180/2 = 16090 \text{ LB.}$$

$$f_{bu} = \frac{7430 \times .434 \times 1.5}{.0242} = 199870 \text{ PSI}$$

$$R_{bu} = \frac{199870}{330000} = .607 \quad \langle 1 \rangle$$

$$f_{su} = \frac{16090 \times 1.5}{.387} = 62360 \text{ PSI}$$

$$R_{su} = \frac{62360}{125000} = .499 \quad \langle 2 \rangle$$

$$M.S. = \frac{1}{1.15(.607 + .499)} - 1 = .11 \quad \langle 3 \rangle$$

<2> REF. 2 P. 28

<1> REF. 2 P 55

<3> FITTING FACTOR

CALC	Goodrich		REVISED	DATE	MAIN GEAR	1510L
CHECK					BOLT	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 176

BOLT CONT.

BEARING OF BOLT IN BUSHING

MATL: ALUM. BRONZE PER AMS 4631

$F_{br} = 101000$ PSI

AREA = .868 X .500 = .434 IN.^{2}

$$f_{br} = \frac{16090 \times 1.5}{.434} = 55610 \text{ PSI}$$

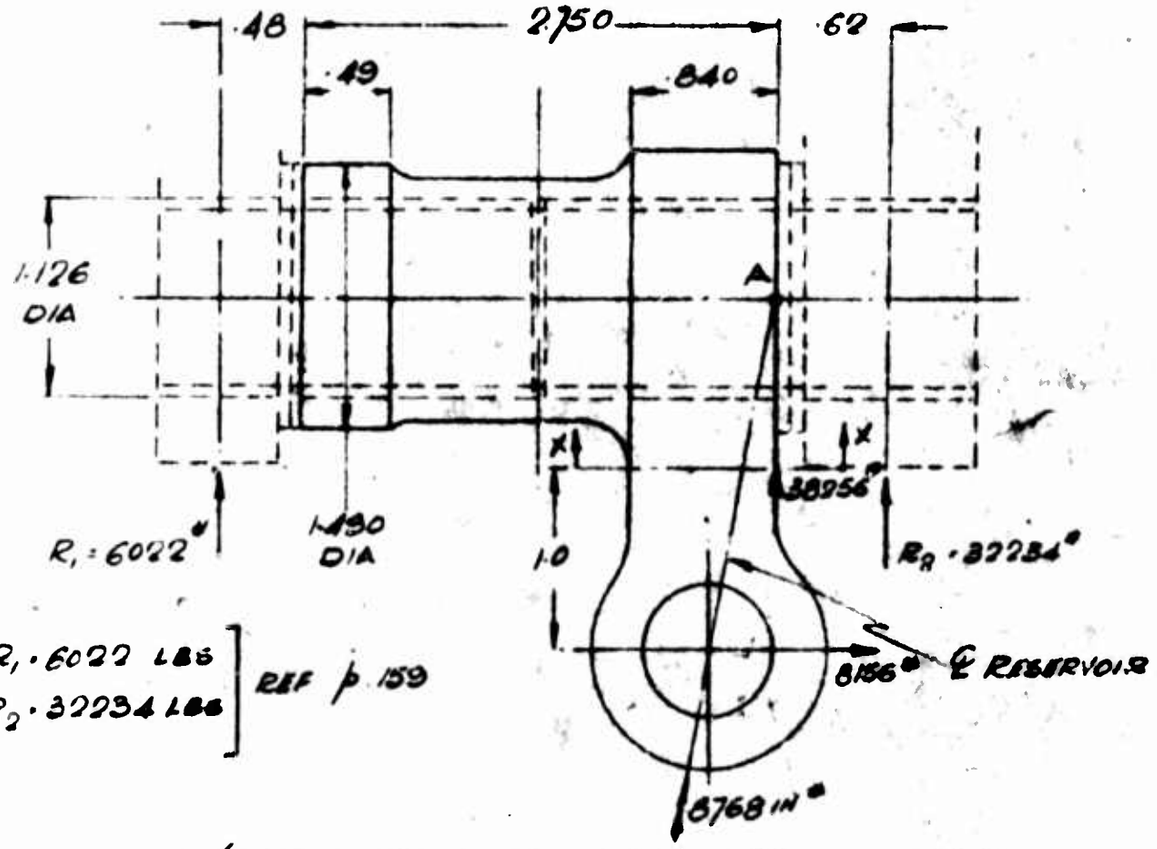
$$M.S. = \frac{101000}{55610} - 1 = .82$$

CALC			REVISED	DATE	MAIN GEAR BOLT	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 177

UNIVERSAL JOINT P/N 1510L406

MAT'L 4340 STEEL
HEAT TREAT 200-220

CONDITION 6 CRITICAL



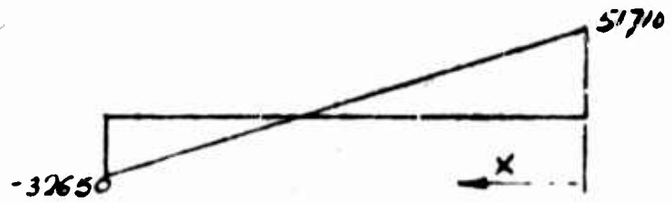
$R_1 = 6022$ LBS
$R_2 = 32234$ LBS
REF p. 159

$$W = \pm 6\left(\frac{1.995 \times 32234 - 1.855 \times 6022}{2.750^3}\right) + \frac{6022}{2.75} \pm \frac{32234}{2.75}$$

$$= \pm 42180 \mp 2190 \pm 11720$$

$$W_1 = 42180 - 2190 + 11720 = 51710$$

$$W_2 = -42180 + 11720 - 2190 = -32650$$



CALC'	[illegible]		REVISED	DATE	MAIN GEAR UNIVERSAL JOINT.	1510L
CHECK						RYAN.
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 178

UNIVERSAL JOINT - CONT

$$B_{br} = 51710 - \frac{51710 + 32650}{2.75}(x)$$

$$= 51710 - 30680x$$

LH SIDE of JOINT.

$$X = 2.75 - .49 = 2.26$$

$$B_{br} = 51710 - 30680(2.26)$$

$$= -17627 \text{ LBS}$$

LOAD ON .49 LENGTH of JOINT

$$= -\frac{32650 - 17627}{2} \times .49 = 12569 \text{ LBS}$$

TENSION.

W = 1.49

O = 1.126

T = .49

$W/O = 1.49/1.126 = 1.32$ $\quad K_t = .990$

$$A_t = (1.49 - 1.126) \times .49 = .178$$

$$F_{tu} = 200000 \text{ psi}$$

$$P'_{tu} = .990 \times 200000 \times .178 = 35244 \text{ LBS}$$

$$MS_{ULT} = \frac{35244}{12569 \times 1.15} - 1 = \underline{+\text{LARGE}}$$

1.15 FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR UNIVERSAL JOINT	1510L
CHECR						RYAN
APR					H W LOUD MACHINE WORKS, INC 867 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 179
APR						

UNIVERSAL JOINT CONT

SHEAR BEARING

$a = .745$

$D = 1.126$

$T = .49$

$a/D = .745/1.126 = .66 \quad K_{br} = .30$

$A_{br} = 1.126 \times .49 = .552$

$P_{bru} = K_{br} F_{tu} A_{br}$

$= .30 \times 200000 \times .552 = 33120 \text{ LBS}$

$MS_{ULT} = \dfrac{33120}{12569 \times 1.15} - 1 = \underline{+ \text{LARGE}}$

(1.15 = FITTING FACTOR)

RH SIDE of JOINT

THIS SIDE of JOINT WILL NOT SEE ANY TENSION OR SHEAR-BEARING LOADS SO AN ASSUMPTION IS MADE THAT HALF THE .840 LENGTH BE USED FOR A BEARING LENGTH

$B_{br} = 51710 - 30680(.85)$

$= 25632 \text{ LBS}$

ASSUMED BEARING LOAD

$= \dfrac{51710 + 25632}{2} \times .420 = 16242 \text{ LBS}$

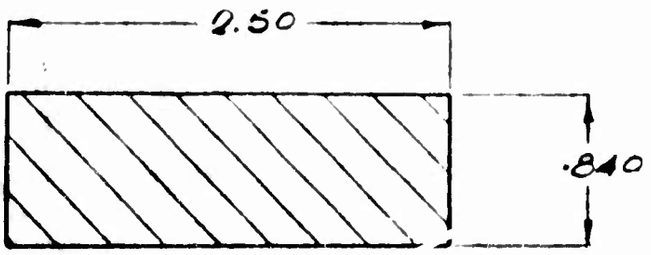
AREA $= .42 \times 1.126 = .4729 \text{ IN}^2 \qquad F_{bru} = 272000 \text{ psi}$

$f_{br} = \dfrac{16242}{4729} = 34346 \text{ psi} \qquad MS_{ULT} = \dfrac{272000}{34346} - 1 = \underline{+ \text{LARGE}}$

CALC			REVISED	DATE	MAIN GEAR UNIVERSAL JOINT	15101
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 867 EAST SECOND ST. POMONA CALIFORNIA	PAGE 180
APR						

UNIVERSAL JOINT - CONT

SECTION X-X



$A = 2.50 \times .840 = 2100 \text{ IN}^2$

$I = \frac{2.50 \times .840^3}{12} = .1235 \text{ IN.}^4$

$M = 8156 \times 1.0 = 8156 \text{ IN. LBS}$

$K = 1.50$

$F_{bu} = 327000 \times 200/220 = 297000 \text{ psi}$

$F_{su} = 119000 \text{ psi} \quad F_{cy} = 198000 \text{ psi}$

$f_{bu} = \frac{8156 \times 1.50 \times .420}{.1235} = 41606 \text{ psi} \quad R_{bu} = \frac{41606}{297000} = .140$

$f_{su} = \frac{8156 \times 1.50}{2.100} = 5826 \text{ psi} \quad R_{su} = \frac{5826}{119000} = .049$

$f_{cy} = \frac{38256 \times 1.50}{2100} = 27326 \text{ psi} \quad R_{cy} = \frac{27326}{198000} = .138$

$f_{st} = \frac{M_t}{oc^2}(3 + 1.8\, c/b)$ - Ref TIMOSHENKO PART I page 270

$= (3 + 1.8 \times .840/2.50) \times \frac{8768 \times 1.50}{2.50 \times .840^2} = 26876 \text{ psi}$

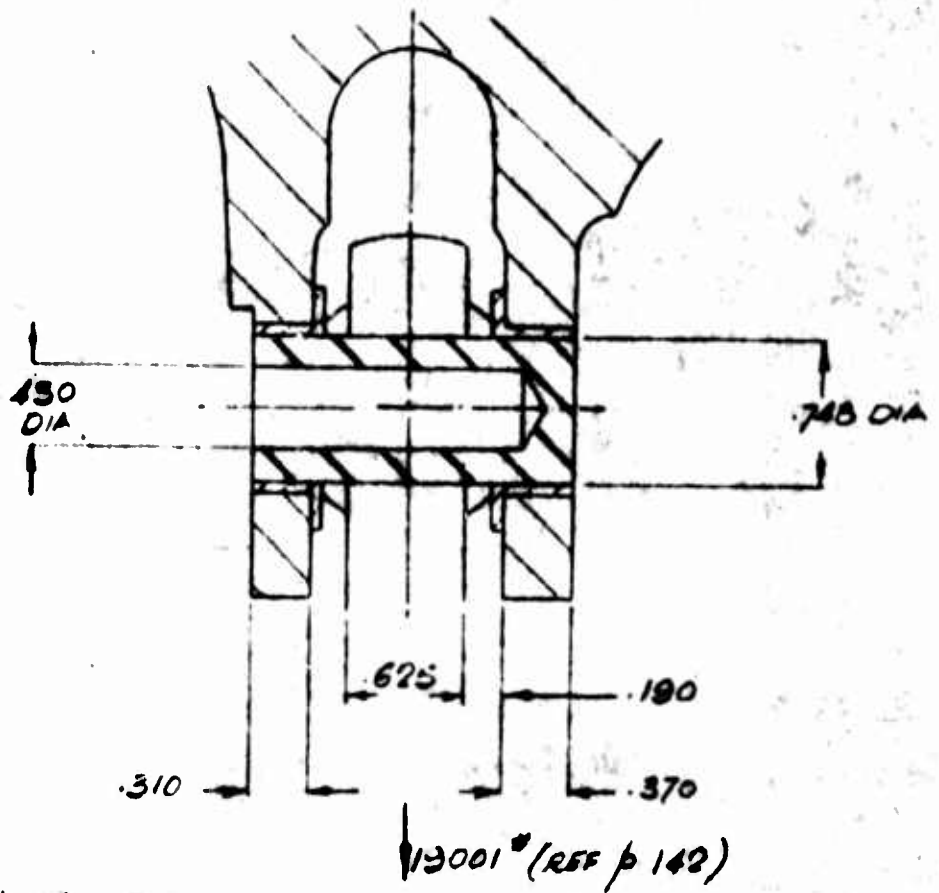
$R_{st} = \frac{26876}{119000} = .226$

$MS_{ULT} = \frac{1}{.138 + (.140^2 + (.049 \times 1.15 + .226)^2)^{\frac{1}{2}}} - 1 = +\text{LARGE}$

CALC			REVISED	DATE	MAIN GEAR UNIVERSAL JOINT	1510L
CHECK						RYAN
APP					H W LOUD MACHINE WORKS INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 181
APP						

SIDE BRACE ATTACH^MT BOLT P/N 1510L414

MAT'L 4340 STEEL
HEAT TREAT 180-200 KSI



POINT of MAX BENDING

$M = (.370/2 + .625/4 + .190) \times 19001 \times .150/2 = 7567$ IN LBS

OD = .748	.4394	.0154	
ID = .430	.1452	.0017	
2t = .318	A = .2942 IN²	I = .0137 IN⁴	
t = .159			

$O/t = .748/.159 = 4.70$

$F_{bu} = 274000$ psi $F_{su} = 109000$ psi

CALC	[illegible]		REVISED	DATE	MAIN GEAR BOLT - UPPER SIDE BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., PERRIS, CALIFORNIA	PAGE 182
APR						

SIDE BRACE ATTACH'MT BOLT · CONT

$$f_{bu} = \frac{7567 \times .374}{.0137} = 206573 \text{ psi}$$

$$MS_{ULT} = \frac{274000}{206573} - 1 = \underline{+.33}$$

AT SHEAR FACE

$$M = (.370/2 + .190) \times 19001 \times 1.50/2 = 5344 \text{ IN LBS.}$$

$$P_s = 19001 \times 1.50/2 = 14251 \text{ LBS.}$$

$$P_t = 3371 \times 1.50 = 5057 \text{ LBS.}$$

$$f_{bu} = \frac{5344 \times .374}{.0137} = 145887 \text{ psi} \qquad R_{bu} = \frac{145887}{274000} = .532$$

$$f_{tu} = \frac{5057}{.2942} = 17189 \text{ psi} \qquad R_{tu} = \frac{17189}{180000} = .095$$

$$f_{su} = \frac{14251}{.2942} = 48440 \text{ psi} \qquad R_{su} = \frac{48440}{109000} = .444$$

$$MS_{ULT} = \frac{1}{(.532 + .095) + .444/1.15)} - 1 = \underline{+.24}$$

FITTING FACTOR

BEARING of BOLT IN BUSHING P/N 1510L215-3

MAT'L ALUM BRONZE AMS 4631

$F_{br} = 101000$ psi

AREA = $.310 \times .748 = .2319$ IN²

$$f_{br} = \frac{14251}{.2319} = 61453 \text{ psi}$$

$$MS_{ULT} = \frac{101000}{61453} - 1 = \underline{+.64}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR BOLT · UPPER SIDE BRACE	1510L
CHECK						RYAN
APP					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 183
APP						

CLEVIS BOLT 1510L416 MAT'L 4340 STEEL
HEAT TREAT 180-200 KSI

P_T = 358 LB. [1]

M_L = 470 × 1.62 = 760 IN.-LB.

MINOR DIA. OF 1/2-20 UNF-3A THD IS .4387 IN.

∴ O.D. = .4387 A = .151 IN.^{2} I = .0018 IN.^{4}

D/t = 2 F_{bu} = 300 000 PSI

$$f_{bu} = \frac{760 \times 1.5 \times .2194}{.0018} = 138950 \text{ PSI}$$

$$R_{bu} = \frac{138950}{300000} = .463$$

$$f_{tu} = \frac{358 \times 1.5}{.151} = 3560 \text{ PSI} \quad R_{tu} = \frac{3560}{180000} = .020$$

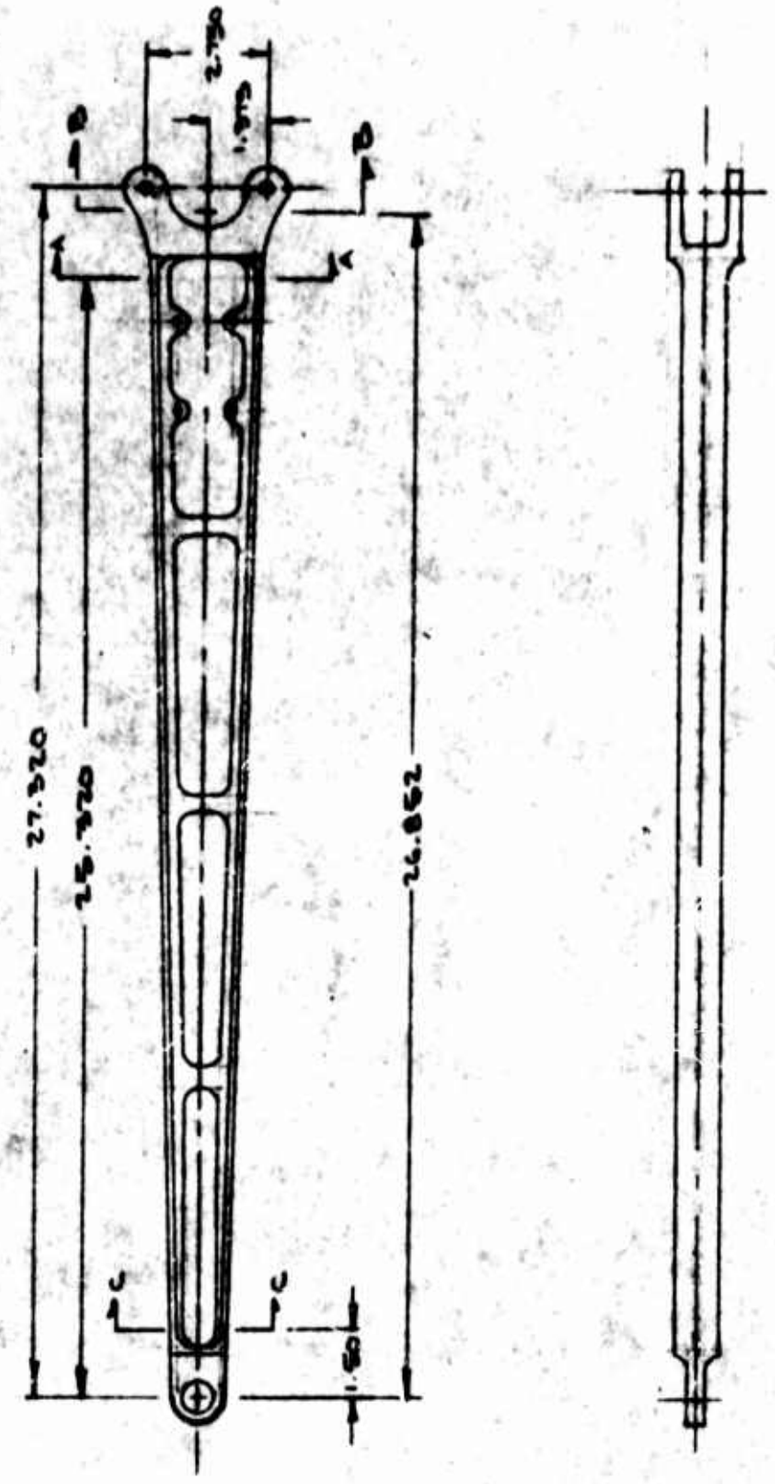
$$M.S. = \frac{1}{.463 + .020} - 1 = 1.07$$

[1] REF. PAGE 192

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					CLEVIS BOLT STABILIZER	RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA CALIFORNIA	PAGE 84

STABILIZER BEAM 1510L402

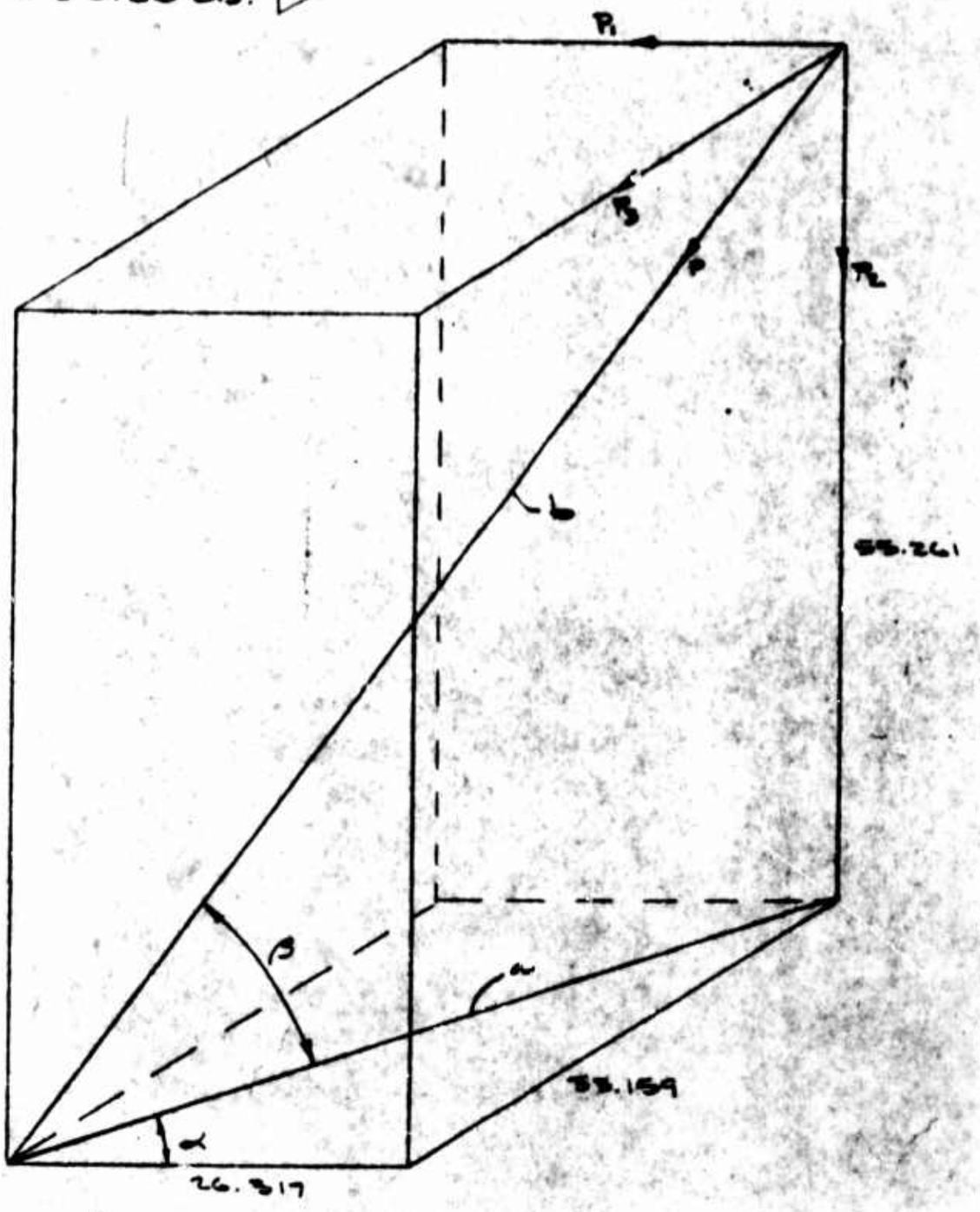
MATL:
7075T6 ALUM. ALLOY
QQ-A-283



CALC	Brodsil		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 185
APR						

STABILIZER BEAM CONT.

P = 32180 LB. (1)



(1) REF. P. 140

CALC	Rabid		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						TRYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 186
APR						

STABILIZER BEAM CONT.

$\tan \alpha = \frac{33.159}{26.317} = 1.25998$ $\quad \sin \alpha = .78326$

$\alpha = 51.56°$ $\quad \cos \alpha = .62169$

$a = \frac{33.159}{.78326} = 42.3346$

$\tan \beta = \frac{55.2614}{42.3346} = 1.30553$ $\quad \sin \beta = .79378$

$\beta = 52.64°$ $\quad \cos \beta = .60821$

$b = \frac{55.2614}{.79378} = 69.6180$

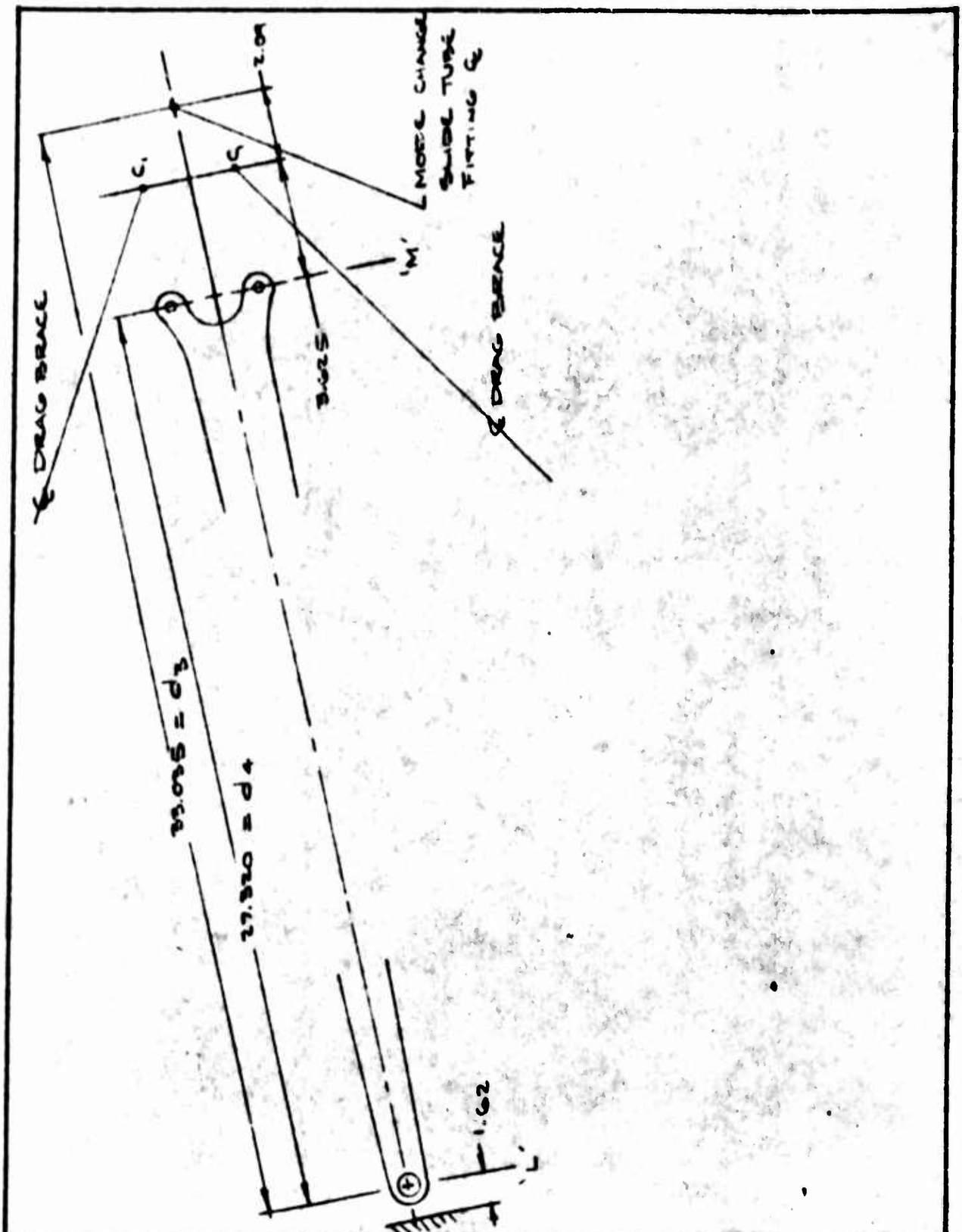
$P_2 = P \sin \beta = 32180 \times .79378 = 25540$ LB.

$P_a = P \cos \beta = 32180 \times .60821 = 19570$ LB.

$P_3 = P_a \sin \alpha = 19570 \times .78326 = 15330$ LB.

$P_1 = P_a \cos \alpha = 19570 \times .62169 = 12170$ LB.

CALC.	Kimball		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L RYAN
CHECK						
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 187

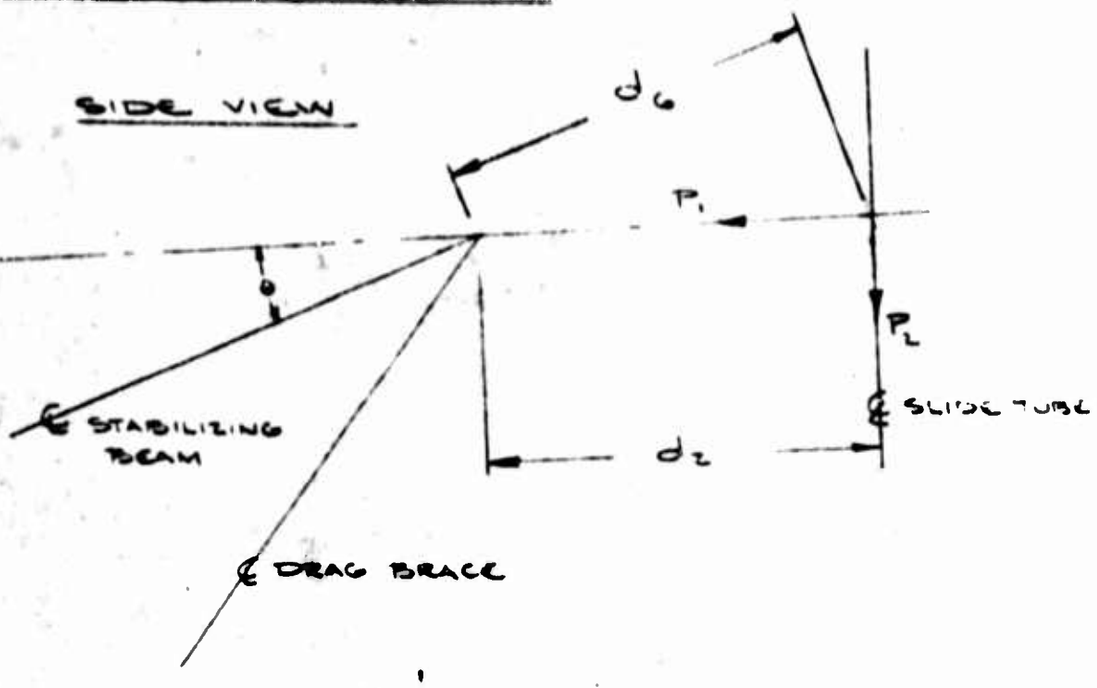


CALC			REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 188
APR						

STABILIZER BEAM

CONDITION 6 CRITICAL

SIDE VIEW

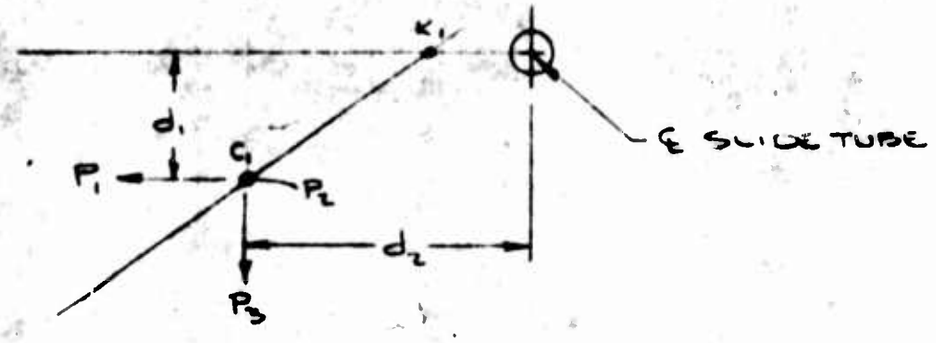


$\theta = 19.50°$

$\sin\theta = .33381$

$\cos\theta = .94264$

TOP VIEW



$d_1 = 1.438$

$d_2 = 2.218$

CALC			REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST POMONA, CALIFORNIA	PAGE 183

STABILIZER BEAM CONT.

$M_V = d_1 P_1 - d_2 P_3$

$= 1.438\ (12170) - 2.218\ (15320)$

$= -16500$ IN.-LB.

$M_V' = M_V \cos\theta = -16500 \times .94264 = -15550$ IN.-LB.

LOAD AT 'L'

$P_L = \frac{M_V'}{d_3} = \frac{15550}{33.035}$

$= 470$ LB.

$d_3 = 33.035$

$d_4 = 27.320$

$d_5 = 2.750$

$d_1 = 2.218 \times \cos\theta$

$= 2.090$

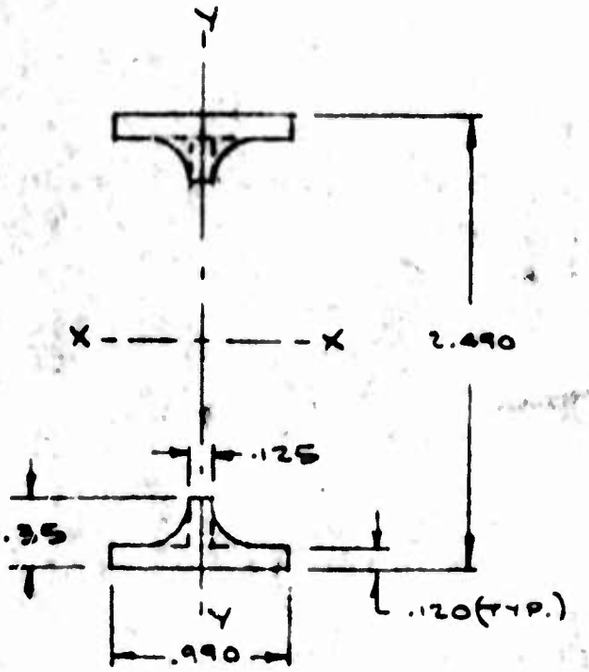
LOAD AT 'M'

$P_M = \frac{M_V'}{d_3} \times \frac{d_4}{d_5} = \frac{15550}{33.035} \times \frac{27.320}{2.750} = 4680$ LB

CALC	Rothil		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 190
APR						

STABILIZER BEAM CONT.

SECTION A-A 25.320 IN. FROM 'L'



NEGLECTING FILLETS (CONSERVATIVE)

$A = 2 \times .125 \times .230 + 2 \times .990 \times .120 = .295 \text{ IN.}^2$

$$I_{X-X} = \frac{(.990 \times 2.490^3) - (.865 \times 2.250^3) - (.125 \times 1.790^3)}{12}$$

$$\frac{15.2838 - 9.8529 - .7169}{12} = .3928 \text{ IN.}^4$$

$Q_{X-X} = .990 \times .120 \times 1.185 + .125 \times .23 \times 1.010$

$= .1698$

$$K_{X-X} = \frac{2 \times .1698 \times 1.245}{.3928} = 1.076$$

$Fbu_{X-X} = \left(\frac{71}{74}\right) 78500 = 75280 \text{ PSI}$

CALC	[illegible]		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1S10L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 191

STABILIZER BEAM CONT

SECTION A-A CONT.

$P_T = 716/2 = 358$ LBS. [1]

$M_{A-A} = 470 \times 25.320 = 11900$ IN.-LBS.

$$f_{bu} = \frac{11900 \times 1.5 \times 1.245}{.3928} = 56570 \text{ PSI}$$

$$R_{bu} = \frac{56570}{75280} = .751$$

$$f_{tu} = \frac{358 \times 1.5}{.295} = 1820 \text{ PSI}$$

$$R_{tu} = \frac{1820}{71000} = .026$$

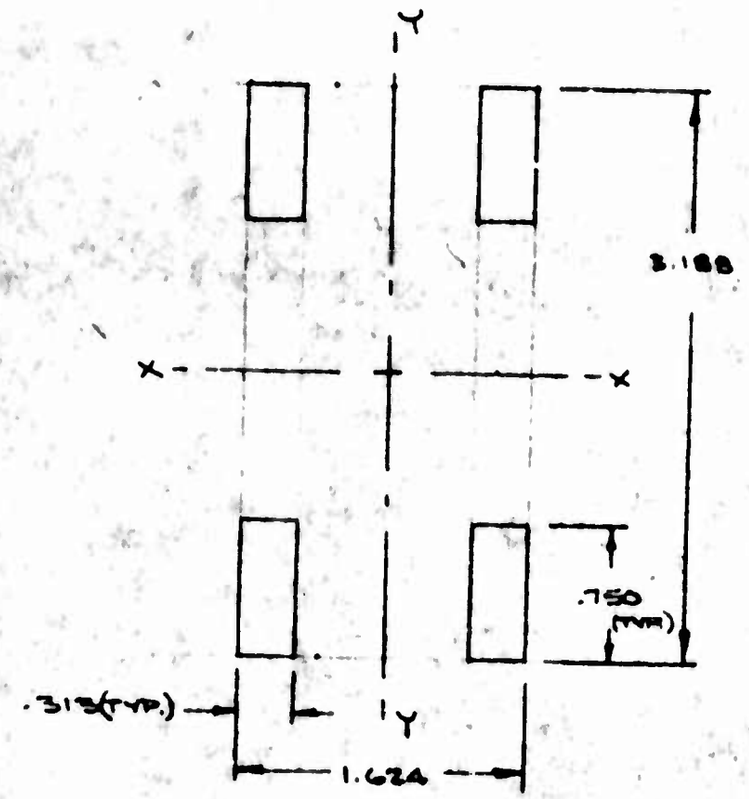
$$M.S. = \frac{1}{.751 + .026} - 1 = .29$$

[1] REF. P. 148

CALC	Burchill		REVISED	DATE	MAIN GEAR STABILIZER BEAM	ISIOL
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 192

STABILIZER BEAM CONT.

SECTION B-B



$A = 4 \times .750 \times .313 = .939$

$$I_{x-x} = \frac{1.624 \times 3.188^3 - .998 \times 3.188^3 - .626 \times 1.688^3}{12}$$

$= 1.439$ IN.^{4}

$Q_{x-x} = .626 \times .750 \times 1.219 = .572$

$$K_{x-x} = \frac{2 \times .572 \times 1.594}{1.439} = 1.267$$

$F_{bu\,x-x} = \left(\frac{71}{74}\right) 90000 = 86310$ PSI

CALC	Bischoff		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1610L
CHECK						RNAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 193
APR						

STABILIZER BEAM CONT.

SECTION B-B CONT.

P_T = 358 LBS. (1)

$M_{B-B} = (27.320 - .468)(470) = 12620$ IN.-LBS.

$$f_{bu} = \frac{12620 \times 1.5 \times 1.594}{1.439} = 20970 \text{ PSI}$$

$$R_{bu} = \frac{20970}{86810} = .243$$

$$f_{tu} = \frac{358 \times 1.5}{.939} = 570 \text{ PSI}$$

$$R_{tu} = \frac{570}{71000} = .008$$

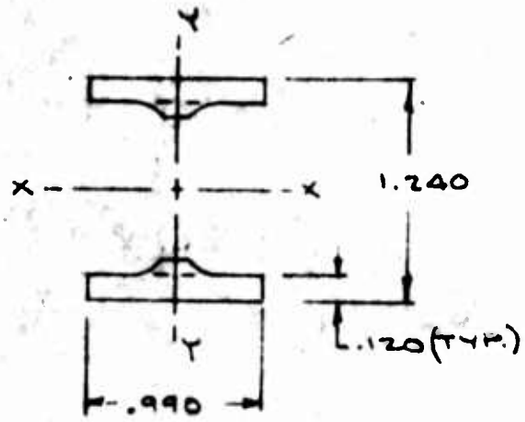
$$M.S. = \frac{1}{.243 + .008} - 1 = 2.98$$

(1) REF. P. 192

CALC	Barbat		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1810L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 194

STABILIZER BEAM

SECTION C-C 1.50 IN. FROM 'L'



NEGLECTING FILLETS (CONSERVATIVE)

$A = 2 \times .990 \times .120 = .238 \text{ IN.}^2$

$I_{x-x} = \dfrac{.990 \times 1.240^3 - .990 \times 1.000^3}{12} = .075 \text{ IN.}^4$

$Q_{x-x} = .120 \times .990 \times .560 = .066$

$K_{x-x} = \dfrac{2 \times .066 \times .620}{.075} = 1.09$

$F_{bu\,x-x} = \left(\dfrac{71}{74}\right) 79500 = 76240 \text{ PSI}$

CALC	[illegible]		REVISED	DATE	MAIN GEAR STABILIZER BEAM — 1510L — RYAN
CHECK					
APR					
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA — PAGE 195

STABILIZER BEAM

SECTION C-C CONT.

$P_Y = 358$ LBS. (1)

$M_{C-C} = 1.500 \times 470 = 705$ IN.-LBS.

$$f_{bu} = \frac{705 \times 1.5 \times .620}{.075} = 8740 \text{ PSI}$$

$$R_{bu} = \frac{8740}{76240} = .115$$

$$f_{tu} = \frac{358 \times 1.5}{.238} = 2260 \text{ PSI}$$

$$R_{tu} = \frac{2260}{71000} = .032$$

$$M.S. = \frac{1}{.115 + .032} - 1 = + \underline{\text{LGE}}$$

(1) REF. P. 192

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					STABILIZER BEAM	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 196

STABILIZER BEAM LUG

LUGS AT 'M'

$P_M = 4680$ LB. (1) $\quad P_T = 358$ LB. (2)

$$\text{LOAD/LUG} = \frac{P_M + P_T}{2} = \frac{5038}{2} = 2520 \text{ LB.}$$

$a = .44 \quad a/D = 1.73$

$D = .254 \quad K_t = .38$

$W = .88 \quad K_{br} = 1.66$

$t = .313 \quad A_{br} = Dt = .0801 \text{ IN.}^2$

$W/D = 3.46 \quad A_t = (W-D)t = .196 \text{ IN.}^2$

TENSION

$$P'_{tu} = K_t F_{tu} A_t = .38 \times 71000 \times .196 = 5254 \text{ LB.}$$

$$\text{M.S.} = \frac{5254}{1.15 \times 2520 \times 1.5} - 1 = \underline{.21}$$

(3)

SHEAR BEARING

$$P_{bru} = K_{br} F_{tux} A_{br} = 1.66 \times 67000 \times .080 = 8900 \text{ LB.}$$

$$\text{M.S.} = \frac{8900}{1.15 \times 2520 \times 1.5} - 1 = \underline{1.05}$$

(3)

LUG YIELD

$$\frac{P'_{u(MIN)}}{A_{br} F_{tu}} = \frac{8900}{.080 \times 71000} = 1.57 \qquad \therefore C = 1.03$$

$$P'_y = C\left(\frac{F_{ty}}{F_{tu}}\right) P'_{u(MIN)} = 1.03\left(\frac{60}{71}\right) 8900 = 7740 \text{ LB.}$$

$$\text{YIELD M.S.} = \frac{1.5 \times 7740}{1.15 \times 2520} - 1 = \underline{+.66}$$

(3)

(2) REF. P. 192

(1) REF. P. 190

(3) FITTING FACTOR

CALC	Burkhart		REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR						
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 197

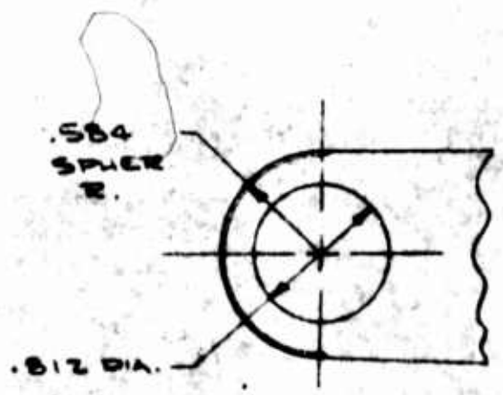
STABILIZER BEAM LUG AT 'L' CONT

P_T = 358 LB. ①

P_L = 470 LB. ②

$P = P_T + P_L$

= 590 LB.



a = .560

D = .812

W = 1.12

t = .401

W/D = 1.38

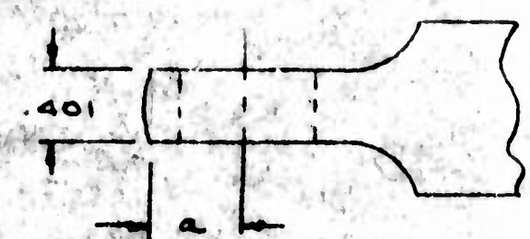
a/D = .69

K_t = .88

K_{br} = .86

$A_{br} = Dt$ = .326 IN.²

$A_t = (W-D)t$ = .124 IN.²



TENSION

$P_{tu} = K_t F_{tu} A_t$ = .88 × 71000 × .124 = 8715 LB.

$$M.S. = \frac{8715}{1.15 \times 590 \times 1.5} - 1 = +\text{LOE}$$

③

② REF. P. 190

① REF. P. 192

③ FITTING FACTOR

CALC			REVISED	DATE	MAIN GEAR STABILIZER BEAM	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 198
APR						

STABILIZER BEAM LUG AT 'L' CONT.

SHEAR - BEARING

$P_{br_w} = K_b \cdot F_{tu_x} A_b = .36 \times 67000 \times .326$

$= 7840$ LB.

$$M.S. = \frac{7840}{1.15 \times 5A0 \times 1.5} - 1 = +LGE$$

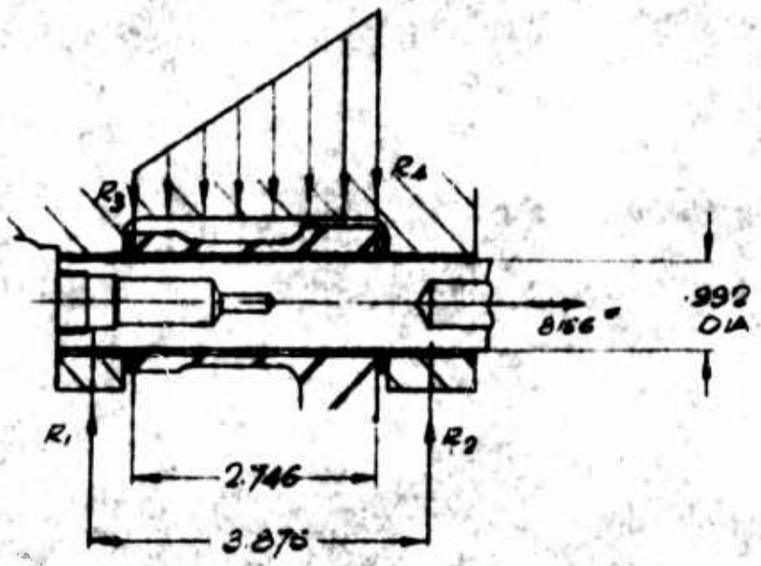
FITTING FACTOR

CALC	[illegible]		REVISED	DATE	MAIN GEAR	1510L
CHECK					STABILIZER BEAM	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 199

ATTACHMT BOLT AT LUG A P/N 1310L407

CONDITION 6 CRITICAL

Matl 4340 STEEL
HEAT TREAT 260-280 KSI



$R_1 = 6022$ LBS
$R_2 = 32234$ LBS
} REF p. 159

TRANSVERSE LOAD = 2263 LBS REF p 148

RESULTANT $R_1 = 6022 \longleftarrow 2263 = 6435$ LBS

RESULTANT $R_2 = 32234 \longleftarrow 2263 = 32310$ LBS

$$q = \frac{6[1.938(32310) - 1.938(6435)]}{2.746^2} \pm \frac{32310 + 6435}{2}$$

$= 39902 \pm 19371$

$R_4 = 39902 + 19371 = 59273$ LBS

$R_3 = 39902 - 19371 = 20531$ LBS.

CALC			REVISED	DATE	MAIN GEAR BOLT - UNIVERSAL	1510L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 200
APP						

ATTACH Mt. BOLT AT LUG A · CONT.

SLOPE of LOAD CURVE = $\frac{59273 - 20531}{2.746} = 14109$ LBS/IN./IN.

POINT of MAX BENDING.

$$32310 \cdot [(2.746 - x)14109 + 20531]x + \tfrac{1}{2}\{59273 - [(2.746 - x)14109 + 20531]\}x$$

$$x^3 - 3.770x + 1.527 = 0$$

$$x = .4615 \text{ IN.}$$

$$M = (.4615 + .990/2)32310 - 52762\left(\frac{.4615^2}{2}\right) - 6511\left(\frac{.4615^3}{3}\right)$$

$$= 11899 \text{ IN LBS.}$$

O.D = .992 $\quad$ A = .7729 IN^2 $\quad$ I = .0475 IN^4

$F_{bu} = 410000$ psi $\quad$ $F_{tu} = 260000$ psi $\quad$ $F_{su} = 149000$ psi

$$f_{bu} = \frac{11899 \times 1.50 \times .496}{.0475} = 186376 \text{ psi} \qquad R_{bu} = \frac{186376}{410000} = .455$$

$$f_{tu} = \text{(1)}\frac{8186 \times 1.50 \times .60}{.7729} = 9497 \text{ psi} \qquad R_{tu} = \frac{9497}{260000} = .037$$

$$MS_{ULT} = \frac{1}{.455 + .037} - 1 = +\underline{LARGE}$$

(1) 60% of AXIAL LOAD PRODUCES TENSION IN BOLT.

CALC			REVISED	DATE	MAIN GEAR BOLT-UNIVERSAL	1510L
CHECK						RYAN
APP					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 201
APP						

ATTACH MT BOLT AT LUG A (CONT.)

AT SHEAR FACE.

$M = 32310 \times .990/2 = 15993$ IN. LBS

$f_{bv} = \frac{15993 \times 1.50 \times .496}{.0475} = 250501$ psi $\quad R_{bv} = \frac{250501}{410000} = .611$

$f_{tv} = \frac{\text{(1)}\ 8156 \times 1.50 \times .60}{.7728} = 9497$ psi $\quad R_{tv} = \frac{9497}{260000} = .037$

$f_{sv} = \frac{32310 \times 1.50}{.7728} = 62706$ psi $\quad R_{sv} = \frac{62706}{149000} = .421$

$$MS_{ULT} = \frac{1}{(.611 + .037)^2 + .421^2 (1.15)^2} - 1 = +.24$$

(1.15) FITTING FACTOR

(1) 60% of AXIAL LOAD PRODUCES TENSION IN BOLT

BEARING of BOLT in BUSHING P/N 15101 215-7

MAT'L ALUM. BRONZE AMS 4631

$F_{br} = 101000$ psi

AREA $= .982 \times .990 = .9821$ IN.^{2}

$f_{br} = \frac{32310 \times 1.50}{.9821} = 49348$ psi

$MS_{ULT} = \frac{101000}{49348} - 1 = +$ LARGE

CALC			REVISED	DATE	MAIN GEAR BOLT - UNIVERSAL	15101
CHECK						RYAN
MGR						
APR					H. W. LOUD MACHINE WORKS, INC. 957 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 202

ATTACHMT BOLT AT LUG A (R. LOAD)

POINT of MAX BENDING

$$6433 = 20531x + \frac{(59273 - 20531)x^2}{2.746 \times 2}$$

$$x = .286 \text{ IN}$$

$$M = (.285 + .990/2)\,6433 = 5018 \text{ IN LBS}$$

OD =	.992	.7729	.0473
ID =	.505	.2008	.0032
2t =	.487	A = .5727 IN²	I = .0443 IN⁴
t =	.2435		

$$D/t = .992/.2435 = 4.074$$

$F_{bu} = 386000$ psi $F_{tu} = 260000$ psi

$$f_{bu} = \frac{5018 \times 1.50 \times .496}{.0443} = 84275 \text{ psi} \qquad R_{bu} = \frac{84275}{386000} = .218$$

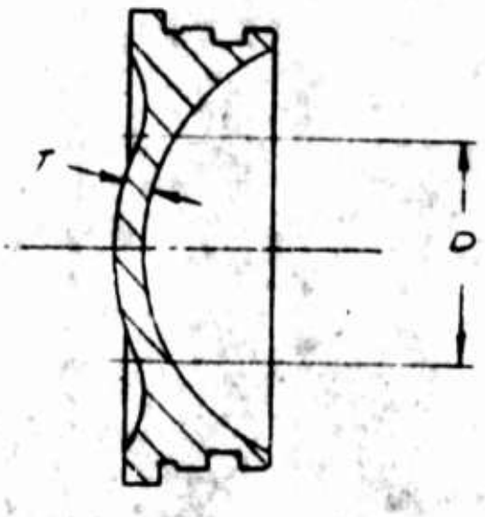
$$f_{tu} = \text{①}\ \frac{8156 \times 1.50 \times .60}{.5727} = 12817 \text{ psi} \qquad R_{tu} = \frac{12817}{260000} = .049$$

$$MS_{ULT} = \frac{1}{.218 + .049} - 1 = \underline{+ \text{LARGE}}$$

① 60% of AXIAL LOAD PRODUCES TENSION IN BOLT

CALC			REVISED	DATE	MAIN GEAR BOLT - UNIVERSAL	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 203
APR						

CYLINDER BULKHEAD P/N 1510L123 MAT'L ALUM. ALLOY 2014-T6



ASSUMED EFFECTIVE DIA (D) = 1.25

MIN EFFECTIVE WALL (T) = .180

BURST PRESSURE = 6600 psi – REF MIL-P-8564-B PARA 3.3

$t = .81 R \sqrt{P/F_{tu}}$ REF HOUGHTON PACKING HANDBOOK p 170

$t = .81 \times .625 \sqrt{\frac{6600}{68000}}$

$= .157$

$F_{tu} = 68000$ psi

$MS_{ULT} = \frac{.180}{.157} - 1 = +.14$

CALC			REVISED	DATE	MAIN GEAR CYLINDER BULKHEAD	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867, EAST SECOND ST., POMONA, CALIFORNIA	PAGE 204
APR						

RETAINING NUT P/N 1510L124 Mat'l ALUM ALLOY 2014-T6

SHEAR ACROSS THREADS

PITCH DIA of THREAD = 2.7053 MIN.

MIN LENGTH of THREAD (ENGAGED) = .41 INS

LOAD DUE TO PRESSURE (BURST) IN RESERVOIR = 32267 LBS — REF p. 65

$$f_{SU} = \frac{32267}{2.7053 \times .41/2 \times \pi} = 18520 \text{ psi}$$

$F_{SU} = 39000$ psi

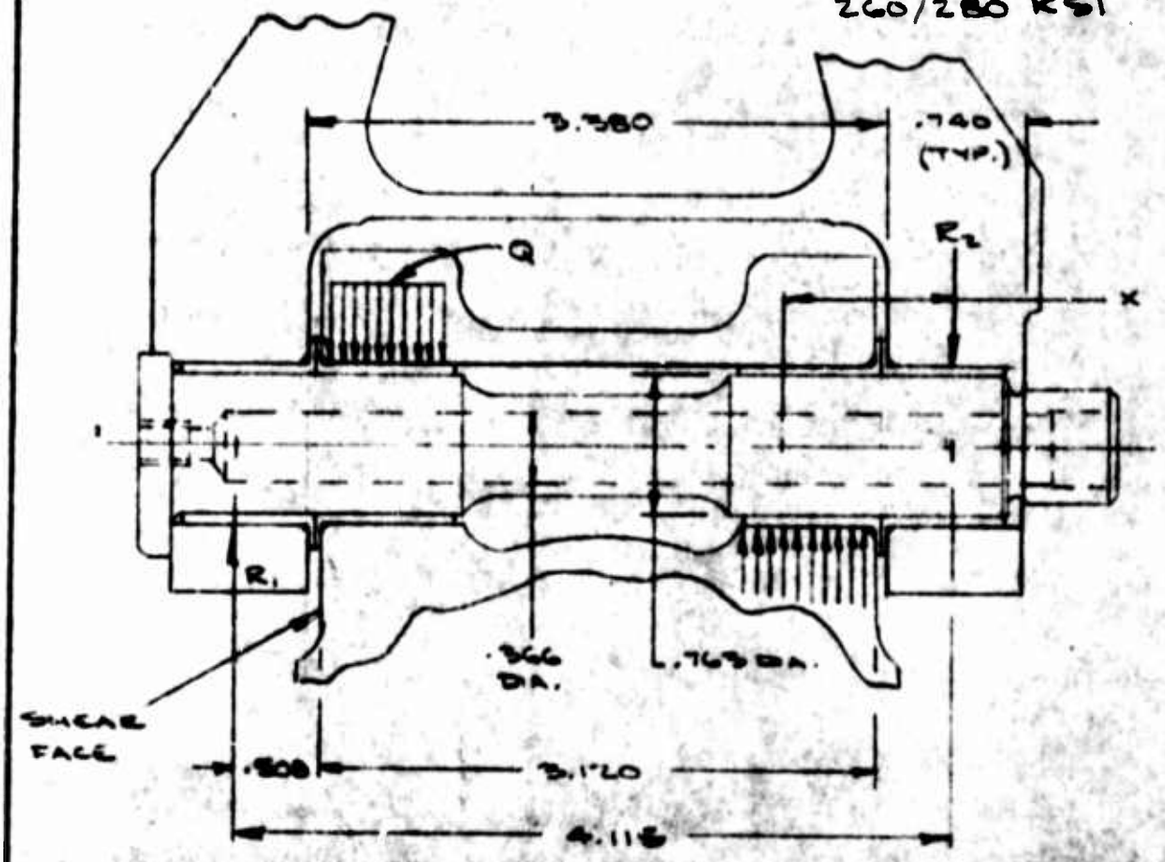
$$MS_{NUT} = \frac{39000}{18520} - 1 = +\text{LARGE}$$

			REVISED	DATE	MAIN GEAR RETAINING NUT	1510L
CALC						RYAN
CHECK						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 205
APR						

END BOLT (TORQUE ARM) 1510L127

CONDITION 6 CRITICAL

4340 STL
260/280 KSI



$$R_1 = R_2 = \frac{8788 \times 7}{4.115} = 14950 \text{ LBS.}$$ (1)

$$Q = \frac{8788 \times 7}{2.38 \times .74} = 34930 \text{ LB./IN.}$$

AT MAX. BENDING

$$(34930)(X - .508) = 14950$$

$$X = \frac{14950}{34930} + .508 = .936$$

(1) REF. P. 85

CALC			REVISED	DATE	MAIN GEAR END BOLT	1510L
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 206

END BOLT CONT.

$$M = 14950 \times .936 - (34930)(.936 - .508)\left(\frac{.936 - .508}{2}\right)$$

$$= 13990 - 3200 = 10790 \text{ IN.-LB.}$$

O.D. =	.763	.457	.017
I.D =	.366	.105	.001
2t =	.397	A = .352 IN.^{2}	I = .016 IN.^{4}
t =	.1985		
D/t =	3.84		

F_{bu} = 389000 PSI [1] F_{su} = 149000 PSI [2]

$$f_b = \frac{10790 \times 1.5 \times .381}{.016} = 385400 \text{ PSI}$$

$$M.S. = \frac{389000}{385400} - 1 = .01$$

AT SHEAR FACE

$$M = 14950 \times .508 = 7595 \text{ IN.-LB.}$$

$$f_{bu} = \frac{7595 \times 1.5 \times .381}{.016} = 271280 \text{ PSI}$$

$$R_{bu} = \frac{271280}{389000} = .697$$

[1] REF. 2 P. 55 [2] REF. 2 P. 28

CALC	[signature]		REVISED	DATE	MAIN GEAR	1510L
CHECK					END BOLT	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 207

END BOLT CONT.

$$f_{su} = \frac{14950 \times 1.5}{.352} = 63710 \text{ PSI}$$

$$R_{su} = \frac{63710}{149000} = .428$$

$$f_{tu} = \frac{8788 \times 1.5}{.352} = 37450 \text{ PSI}$$

$$R_{tu} = \frac{37450}{260000} = .144$$

$$M.S. = \frac{1}{.697 + .144 + .428} - 1 = .06$$

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					END BOLT	RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 200

END BOLT CONT

SHANK IN TENSION

$A_t = .7854 (.490^2 - .366)^2 = .083 \text{ IN}^2$

$f_{tu} = \frac{8788 \times 1.5}{.083} = 158820 \text{ PSI}$

$M.S. = \frac{260000}{158820} - 1 = .64$

THD'S IN SHEAR (.625-18 UNF-3ATHD)

$P.D. = .5854$

$A_s = \frac{3.14 \times .5854 \times .39}{2} = .358 \text{ IN.}^2$

$F_{su} = 149000 \text{ PSI}$

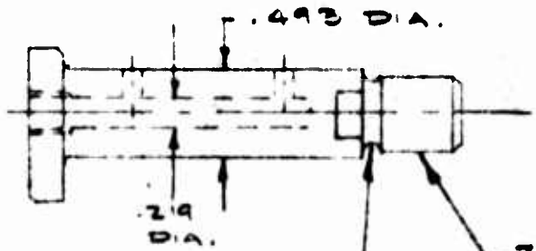
$f_{su} = \frac{8788 \times 1.5}{.358} = 36820 \text{ PSI}$

$M.S. = \frac{149000}{36820} - 1 = +.06$

CALC			REVISED	DATE	MAIN GEAR END BOLT	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 209
APR						

APEX BOLT 1510L129

4140 STL
180/200 KSI



R_T = 8788 LB. [1]

AT RELIEF DIA.

$A_t = .7854(.350)^2 = .096$ IN.^{2}

$f_{tu} = \frac{8788 \times 1.5}{.096} = 137310$ PSI

$M.S. = \frac{180000}{137310} - 1 = .31$

THD'S IN SHEAR

$A_s = \frac{3.14 \times .402 \times .44}{2} = .278$ IN.^{2}

$F_{su} = 109000$ PSI [2]

$f_{su} = \frac{8788 \times 1.5}{.278} = 60460$ PSI

$M.S. = \frac{109000}{60460} - 1 = .80$

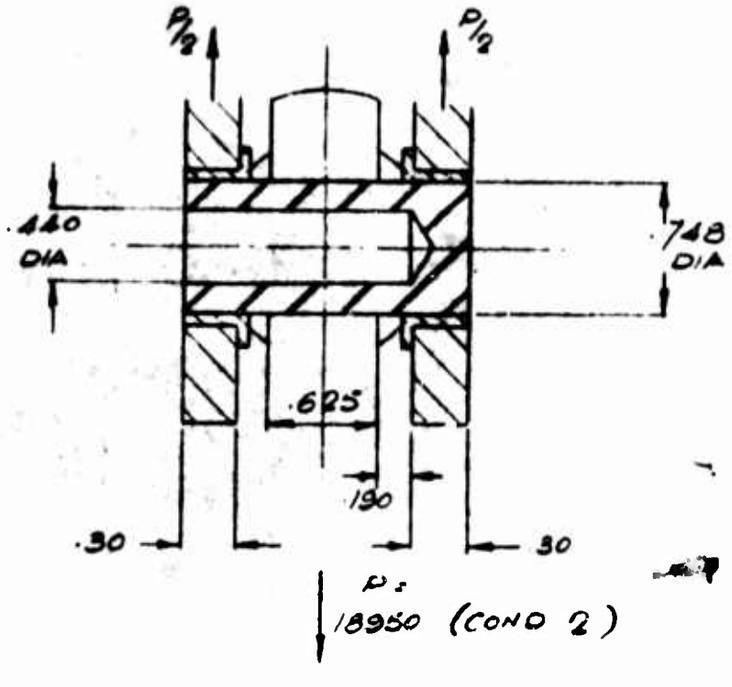
[1] REF. P. 41

[2] REF. 2 P. 28

CALC			REVISED	DATE	MAIN GEAR	1510L
CHECK					APEX BOLT	RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 210
APR						

SIDE BRACE ATTACH^MT BOLT - CYLINDER P/N 15101131

MAT'L 4340 STEEL
HEAT TREAT 180-200 KSI



POINT of MAX BENDING

$$M = \left(\frac{.30}{2} + \frac{.625}{4} + .190\right) \times 18950 \times \frac{1.50}{2} = 7049 \text{ IN. LBS}$$

O.D. = .748
I.D. = .440
2t = .308
t = .154

.4394
.1521
A = .2873 IN²

.0154
.0018
I = .0136 IN⁴

$$D/t = .748/.154 = 4.86$$

$F_{bu} = 274000$ psi $F_{su} = 169000$ psi

$$f_{bu} = \frac{7049 \times .374}{.136} = 193848 \text{ psi}$$

$$MS_{ULT} = \frac{274000}{193848} - 1 = \underline{+.41}$$

CALC			REVISED	DATE	MAIN GEAR BOLT - SIDE BRACE	15101
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 867 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 211
APR						

SIDE BRACE ATTACH^{MT} BOLT - CYLINDER CONT.

AT SHEAR FACE

$M = (.30/2 + .190) \times 18950 \times 1.50/2 = 4832$ IN LBS.

$P_s = 18950 \times 1.50/2 = 14213$ LBS.

$f_{bu} = \frac{4832 \times .374}{.0136} = 132880$ psi $\qquad R_{bu} = \frac{132880}{274000} = .485$

$f_{su} = \frac{14213}{.2873} = 49471$ psi $\qquad R_{su} = \frac{49471}{109000} = .454$

$$MS_{ULT} = \frac{1}{.485 + .454(1.15)^2} - 1 = \underline{+.40}$$

FITTING FACTOR

BEARING of BOLT IN BUSHING P/N 15104215-18

MAT'L ALUM BRONZE AMS 4681

$F_{br} = 101000$ psi

AREA $= .748 \times .30 = .2244$ IN^2

$f_{br} = \frac{18950 \times 1.50}{.2244 \times 2} = 63336$ psi

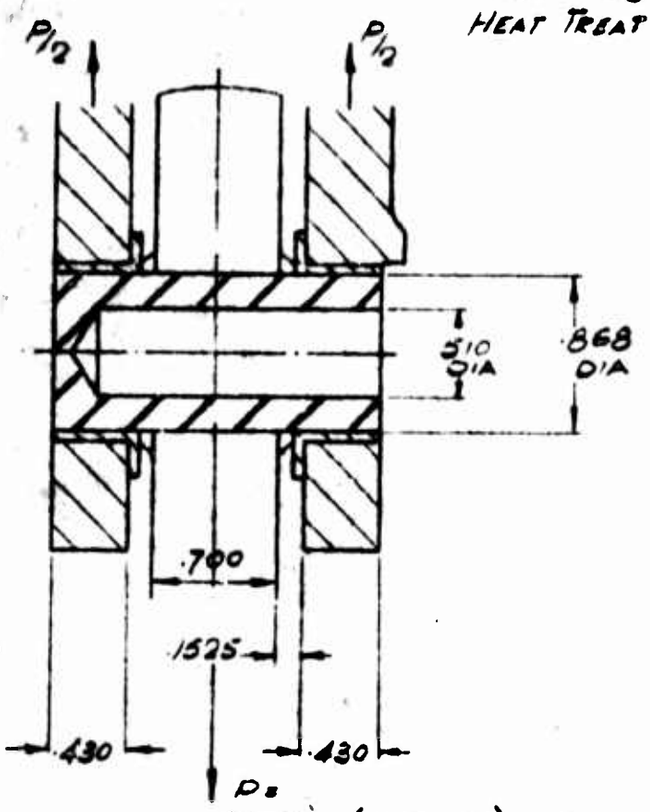
$$MS_{ULT} = \frac{101000}{63336} - 1 = \underline{+.59}$$

CALC			REVISED	DATE	MAIN GEAR BOLT - SIDE BRACE	15104
CHECK						RYAN
APR						
APR					H. W. LOUD MACHINE WORKS, INC. 667 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 212

DRAG STRUT ATTACH MT BOLT - CYLINDER

P/N 1510L133

MAT'L 4340 STEEL
HEAT TREAT 180-200 KSI



POINT of MAX BENDING

$$M = (.430/2 + .700/4 + 1.525) \times 32180 \times 1.50/2 = 13093 \text{ IN LBS}$$

O.D. = .868	.5917	.0279
I.D. = .510	.2043	.0033
2t = .358	A = .3874 IN²	I = .0246 IN⁴
t = .179		

$D/t = .868/.179 = 4.85$

$F_{bu} = 274000$ psi $F_{su} = 109000$ psi

$$f_{bu} = \frac{13093 \times .434}{.0246} = 230990 \text{ psi}$$

$$M.S._{ULT} = \frac{274000}{230990} - 1 = \underline{+.19}$$

CALC	[illegible]		REVISED	DATE	MAIN GEAR BOLT - DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 213
APR						

DRAG STRUT ATTACH^MT BOLT - CYLINDER - CONT

AT SHEAR FACE

$M = (.430/2 + .1525) \times 32180 \times 1.50/2 = 8870$ IN LBS.

$P_s = 32180 \times 1.50/2 = 24135$ LBS.

$f_{bu} = \frac{8870 \times .434}{.0246} = 156487$ psi $\qquad R_{bu} = \frac{156487}{274000} = .571$

$f_{su} = \frac{24135}{3874} = 62300$ psi $\qquad R_{su} = \frac{62300}{109000} = .572$

$$MS_{ULT} = \frac{1}{.571 + .572(1.15)} - 1 = \underline{+.15}$$

(1.15 = FITTING FACTOR)

BEARING of BOLT IN BUSHING P/N 1510L215-17

MAT'L ALUM BRONZE AMS 4631

$F_{br} = 101000$ psi

AREA $= .868 \times .430 = .3732$ IN^2

$f_{br} = \frac{32180 \times 1.50}{.3732 \times 2} = 64670$ psi

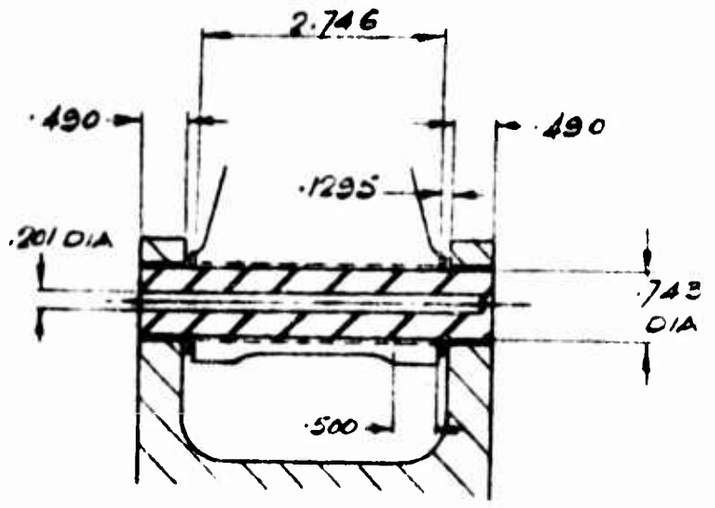
$$MS_{ULT} = \frac{101000}{64670} - 1 = \underline{+.56}$$

CALC			REVISED	DATE	MAIN GEAR BOLT - DRAG BRACE	1510L
CHECK						RYAN
APR					H. W. LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 214
APR						

CYLINDER ATTACH MT BOLT P/N 15101135

MAT'L 4340 STEEL

HEAT TREAT 260-280 KSI.



POINT of MAX BENDING

RESULTANT BENDING LOAD = $3911\frac{7}{2} \longleftrightarrow 8768\frac{1}{2}$ = 20040 LBS PER LUG

$$\frac{20040 \times 2}{2.746} = 14596 \text{ LBS/IN}$$

ASSUMING POINT of MAX BENDING IS .23 FROM OUTER FACE OF INNER MEMBER

M = 20040 x (.25 + .1295 + .150) - 14596 x .250 x .125 = 10156 IN LBS

O.D = .743	.4336	.0150
I.D = .201	.0317	.0001
2t = .542	A = .4019 IN²	I = .0149 IN⁴
t = .271		

$D/t = .743/.271 = 2.74$

F_{bu} = 405000 psi F_{su} = 149000 psi

$$f_{bu} = \frac{10156 \times 1.50 \times .3715}{.0149} = 379790 \text{ psi}$$

$$MS_{ult} = \frac{405000}{379790} - 1 = +.07$$

CALC			REVISED	DATE	MAIN GEAR BOLT - SHOCK STRUT ATTACH MT	15101
CHECK						RYAN
APR					H W LOUD MACHINE WORKS, INC 887 EAST SECOND ST. POMONA, CALIFORNIA	PAGE 215
APR						

CYLINDER ATTACH'MT BOLT - CONT.

AT SHEAR FACE

$M = 20040 \times (\frac{.300}{2} + .1295) = 5601$ IN. LBS

$P_s = 20040$ LBS

$f_{bu} = \frac{5601 \times 1.50 \times .3715}{.0149} = 209474$ psi $\qquad R_{bu} = \frac{209474}{405000} = .517$

$f_{su} = \frac{20040 \times 1.50}{4019} = 74795$ psi $\qquad R_{su} = \frac{74795}{149000} = .502$

$$MS_{ULT} = \frac{1}{.517 + (.502/1.15)} - 1 = +.29$$

(1.15 = FITTING FACTOR)

BEARING of BOLT IN BUSHING P/N 1510L139

MAT'L ALUM. BRONZE AMS 4681

$F_{br} = 101000$ psi

AREA $= .743 \times .490 = .364$ IN.^{2}

$f_{br} = \frac{20040 \times 1.50}{.364} = 82582$ psi

$$MS_{ULT} = \frac{101000}{82582} - 1 = +.22$$

CALC			REVISED	DATE	MAIN GEAR BOLT - SHOCK STRUT ATTACH'MT	1510L
CHECK						RYAN.
APR					H W LOUD MACHINE WORKS, INC. 887 EAST SECOND ST., POMONA, CALIFORNIA	PAGE 216
APR						